

CHAPTER 5

Modernizing Infrastructure

I. EXECUTIVE SUMMARY

As a result of years of inadequate investment and neglect of repairs and maintenance, Cuba's infrastructure has significantly deteriorated. Examples of the abysmal state of Cuba's infrastructure are not difficult to identify from published reports and personal accounts. The only investment realized in Cuba's transportation infrastructure over the last two decades has been to support the narrow interests of the tourism market, not the general population. Ports, roads, and bridges suffer from a lack of investment, as do many of the supporting components of a healthy transportation and distribution system.

To assist a transition government in Cuba and meet humanitarian, as well as reconstruction challenges, significant infrastructure investments will be needed in transportation systems, energy, telecommunications, water resources, and sanitation. This chapter provides an overview of Cuba's infrastructure using all available sources of information and reflects how the U.S. Government can assist a transition government in Cuba to meet humanitarian and reconstruction challenges.

The chapter's first section focuses on the first 90 days and actions that support humanitarian assistance. Since infrastructure, by definition, implies facilities and equipment that are unlikely to be built or acquired in a 90-day timeframe, this section of the report will identify short-term actions, such as operational changes and signing of new cooperative agreements, that can facilitate the most rapid assistance to the Cuban people in a time of transition. This section will also identify the areas of infrastructure in need of on-site technical evaluation to establish needs and priorities for longer-term infrastructure.

In the short-term, the U.S. Government can assist a free Cuba and its citizens by facilitating the acquisition of new and/or used equipment, opening avenues of cooperation between public/private U.S. transport entities and their Cuban counterparts, conducting technical needs assessments, and providing technical assistance to formulate an infrastructure development plan that will identify emergency requirements as well as medium- and long-term needs.

To address long-term infrastructure needs, elements of the U.S. Government can support a free Cuba in seeking donor assistance from the

international community and organizations such as the World Bank and the Inter-American Development Bank to help finance feasibility studies, assess and prioritize needs, improve the operation and financial viability of public utilities, upgrade and replace plants and equipment, undertake the privatization of utilities, encourage competition in services, and develop regulatory mechanisms for natural monopolies.

II. INTRODUCTION

Sound physical infrastructure is required for any country to develop and sustain economic growth and quality of life for its citizens. It is the backbone of social and economic development, and for a transitioning Cuba, it will be critical for success. After years of inadequate investment and neglect of repairs and maintenance, Cuba's infrastructure is in a state of serious deterioration. All basic infrastructure, including transportation, energy, telecommunication, and water and sanitation facilities have suffered, and all such systems are antiquated, unreliable, and incapable of supporting the increased demands associated with an open, consumer-oriented, market-based economy.

Infrastructure development and maintenance is capital intensive. For nearly 30 years, Cuba received large subsidies, principally from the former Soviet Union, and mostly via concessionary sugar-for-oil agreements. Wasting this capital on military adventurism, the Castro regime ignored the day-to-day infrastructure needs of the nation, which is in part responsible for the long-term damage to the economy. Since the Soviet Union's collapse in 1991 and Cuba's loss of what had been a \$6 billion a year subsidy, Cuba's state-planned economy has had difficulty generating sustainable revenue. Capital shortages are reflected in a pattern of deferred maintenance and a lack of renewal of the country's infrastructure. Even before the break-up of the Soviet Union, Cuba's showed the damages of its ideologically based, state-planned system, with its distortions and misplaced subsidies that favored inefficient operation of state-run enterprises for political reasons at the expense of market-driven production.

Regardless of these economic constraints, the Cuban government has spent disproportionately large sums of money to establish its influence in many third world countries through both military and foreign aid expenditures. Large sums were also directed to activities such as the development of biotechnology and bioscience centers not appropriate in

magnitude and expense for such a fundamentally poor nation, and which have failed to be justified financially. In fact, this sector has continued to receive heavy investment despite cutbacks in other sectors of the economy, one of which has been basic infrastructure. The investment in the biotech sector has not resulted in significant inflows of capital, and has raised questions about the types of activities undertaken.¹

Examples of the abysmal state of Cuba's infrastructure are not difficult to identify from published reports and personal accounts. The collapse of the sugar industry has led to a substantial reduction in rail assets, with more than a third of the rail network — itself antiquated and very poorly maintained — being mothballed. The rail signaling system dates from the middle of the last century, and is in need of substantial improvement. Ports, roads, and bridges similarly suffer from a lack of investment, as do many of the supporting components of a healthy transportation and distribution system. For example, firms now doing business in Cuba report a significant shortage of warehousing facilities, particularly refrigerated warehousing facilities, with implications both for the transportation system and the ability to serve the population's basic food and health needs.

In the electric energy generation sector, several factors have led to a serious deterioration of the Cuban system, including lack of proper maintenance, use of inappropriate fuel, aging equipment, unsuitable spare parts, lack of system equilibrium, and the effects of blackouts. Some sources estimate Cuba's current real capacity at only 1,200 megawatts. In a free Cuba, the infrastructure will need to be modernized to generate 3,900 megawatts as soon as possible to help support economic development. A robust capacity for generating electrical energy will be essential.²

Telecommunications is one of the most important areas of infrastructure investment. In the last 30 years, the world has witnessed a revolution in telecommunications technology in which Cuba has barely participated. Microwaves, fiber optics, satellites, wireless phones, digital switching, computer networking, Internet, electronic mail, faxes, and interactive television are all examples. During the course of Castro's revolution, Cuba's telecoms capacity actually decreased, going from 15

¹ Cereijo, Manuel, *Cuba's Infrastructure: Present and Future*, Institute for Cuban & Cuban-American Studies, University of Miami, 2003.

² Ibid.

telephone lines per 100 inhabitants in 1959 to 3.5 lines per 100 persons in 1999. Moreover, many of the existing lines and systems are not suitable for the speed, bandwidth, and applications of modern telecommunications.³

Similarly, infrastructure associated with water and sanitation has suffered since the 1959 revolution. Little or no maintenance has been given to plants, distribution, collection, and transmission systems due to lack of investment due to antiquation and a shortage of spare parts. Water and sanitation facilities in the urban areas of Cuba are an average of 70 years old. The universally accepted useful life of water distribution and sewer lines is 50 years, and then only when reliable, routine maintenance is performed.⁴

These examples are typical of a wider pattern of inadequate and failing infrastructure due to age, lack of investment, poor maintenance, and failure to acquire necessary spare parts. The transport system, and virtually all other aspects of Cuba's infrastructure that support its society, suffer from the same lack of attention and consequent degradation. To assist a free Cuba and its citizens, all aspects of the existing infrastructure will need to be examined and modernized in order to support and foster broader economic growth, social development, and democratic institution-building.

This chapter provides an overview of Cuba's infrastructure using all available sources of information and reflects how the U.S. Government can assist a transition government in Cuba to meet humanitarian and reconstruction challenges. The chapter's first section focuses on the first 90 days and actions that support humanitarian assistance. Since infrastructure, by definition, implies facilities and equipment that are unlikely to be built or acquired in a 90-day timeframe, this section of the report will identify short-term actions, such as operational changes and signing of new cooperative agreements, that can facilitate the most rapid assistance to the Cuban people in a time of transition. This section will also identify the areas of infrastructure in need of on-site technical evaluation to establish needs and priorities for longer-term infrastructure. Long-term issues are addressed in the chapter's second section. Throughout the chapter, actions where the U.S. Government may provide assistance to a free Cuba are shown in *italics*. Recommendations represent a best estimate based on the available information.

³ Ibid.

⁴ Ibid.

III. IMMEDIATE ACTIONS⁵

A. Transportation

1. Aviation

i. Air Traffic Management/Airway Facilities

To facilitate coordination and hand-offs and improve flow management for a projected increase in air traffic, once a transition government is in place, the Federal Aviation Administration (FAA) and the Institute of Civil Aeronautics of Cuba (IACC) should agree to establish liaison positions in both the Havana Air Traffic Control Center (ACC) and the Miami Air Route Traffic Control Center (ARTCC) for immediate exchange of controllers and the development of a flow management unit. The FAA will need to identify a bilingual FAA liaison that is operationally current, that is familiar with the Cuban ATC environment (from the Miami ARTCC), and that has a broad background in traffic management, procedural development, and instruction. The liaison would also require extensive knowledge of International Civil Aviation Organization (ICAO) standards and recommended practices. The liaison would be located at the Havana Center for a period of up to 12 months.

RECOMMENDATIONS:

- *Once a transition government is in place, seek a Technical Assistance Agreement for immediate exchange of controllers (Miami and Havana) to facilitate coordination and hand-offs and improve Flow Management for projected traffic increases.*
- *Encourage a transition government to establish a liaison at the Miami ARTCC facility to facilitate coordination in the new air traffic environment.*

The accurate and efficient transmission and reception of critical voice and data communications are crucial for the safe management of air traffic, particularly when automated data exchange is not available. The current

⁵ Actions that may be taken in the first 90 days of a post-transition government.

communications arrangement and system between Cuba and the United States is barely sufficient for current traffic levels and is inadequate for accommodating the projected growth in traffic. The FAA and the IACC should jointly examine point-to-point (Havana-Miami initially) options for expanding bilateral communications capabilities to ensure the safe transmission of critical information. Experts from the ICAO's MEVA (*Mejores al Enlace de Voz del ATS*) Project Team for Latin America and the Caribbean should be involved in the discussions.

RECOMMENDATIONS:

- *Provide assistance with restructuring radar sectors and improving operational procedures.*
- *Advise on upgrading communications systems.*

ii. Safety Oversight

The FAA has a statutory obligation to ensure the safe operation of foreign aircraft operating in the United States. When a foreign air carrier files an application for direct service to the United States, the FAA conducts an International Aviation Safety Assessment (IASA) to determine the foreign government's level of compliance with ICAO standards. Given the level of U.S. Government interest and the likely interest of any airline based in a free Cuba to begin operations to the United States following the normalization of relations, the FAA should be prepared to assign a technical team to conduct a review of the aviation safety oversight system as soon as it is feasible.

RECOMMENDATIONS:

- *Conduct technical review to determine compliance with ICAO standards. The technical evaluation would focus on the following areas:*
 - *Runway and taxiway conditions;*
 - *Lighting and marking;*
 - *Airport signs;*

- *Runway safety areas;*
- *Airport rescue and firefighting;*
- *Emergency planning; and*
- *Airport operating personnel.*
- *Following the onsite evaluation, the technical team would prepare a report documenting existing conditions and assist in creating an action plan for bringing airports into compliance with ICAO standards. The technical team would spend approximately 14 days in Cuba for the evaluation. The report could be completed within 60 days.*

Based on the results of the technical review, the U.S. Government should provide the resources necessary for a team of safety experts, FAA or contractual as appropriate, to work with Cuban IACC officials to correct any deficiencies in the Cuban government's safety oversight system.

- *Provide technical assistance as needed to bring the Civil Aeronautic Institute of Cuba into compliance with ICAO standards.*

iii. Airports

In preparation for an immediate response to humanitarian assistance needs and the need to expedite air cargo shipments, a technical evaluation of all of Cuba's airports and their compliance with ICAO standards must first be conducted. Once a free Cuban government exists, FAA airport experts would need to perform a technical evaluation of several major airports in Cuba to determine the current level of compliance with ICAO standards. A team of airport safety specialists would need to visit three of Cuba's major international airports to identify immediate safety concerns and interim solutions, including Jose Marti International Airport at Havana; Juan Gualberto Gomez International Airport at Varadero; and Antonio Maceo Airport at Santiago.

RECOMMENDATIONS:

- *Conduct technical evaluation of major airports in Cuba for compliance with ICAO standards.*

- *Provide technical assistance/training to achieve ICAO compliance as needed.*
- *Develop a forecast based on increased U.S. passenger traffic at three principal airports.*
- *Identify possible means to increase capacity and expand/modernize facilities.*
- *Assist in the development of new emergency/contingency plans to meet the projected increased demand.*
- *Conduct aircraft rescue and firefighting audit and training as needed.*

iv. Security Infrastructure and Oversight of Air Operations

For security staffing at key gateways, additional staffing for security checkpoints could be realized by realigning resources within the airports. Other measures include authorizing overtime for the current staff and using the National Screening Force to augment screeners in order to meet surge requirements. As the volume stabilizes, additional screeners may be needed to accommodate an increase in passenger volume. Compliance with U.S. security requirements, as expressed in Aviation Security Plans, Security Directives, and Emergency Amendments, is required.

For a foreign airport to be authorized to provide last point of departure service to the United States, a request must be submitted to the Department of Transportation (DOT). DOT confers with several U.S. Government entities (e.g., Transportation Security Administration [TSA], Federal Aviation Administration [FAA], other DOT components) in developing the response to this request. TSA's evaluation involves sending a survey team to the airport to determine the existing security posture and to ascertain whether a more in-depth assessment is required prior to initiating service. Surveys and/or assessments include reviews of aviation security components such as passenger and baggage screening procedures, cargo handling, physical security at the airport, and established policies. Once TSA is confident that the security level meets ICAO Standards and Recommended

Practices (SARPs), an advisory of any aviation concerns is submitted to DOT.⁶

RECOMMENDATION:

- *Conduct airport assessments in Cuba prior to granting a Cuban airline permission to serve as the last point of departure for the United States.*

The Transportation Security Area Representative (TSAR) Program was initiated in 1990 as a result of the downing of Pan Am flight 103. Created in the Aviation Security Improvement Act of 1990 (49 U.S.C. appendix 1301 note), the position of TSAR (formerly referred to as Civil Aviation Security liaison Officer) was established to promote alignment and consistency between the security requirements of the U.S. and foreign governments. This position was also designed to foster reciprocal relationships with host countries to ensure the safety and security of the air transportation system. The Act established the TSAR position as the principal representative of TSA in all matters relating to transportation security in a designated area of responsibility. Once additional direct commercial services begin between the two countries in a transition context, liaison activity will be required.

RECOMMENDATION:

- *Provide guidance on compliance with U.S. security requirements, to*

⁶ Prior to the arrival of a TSA assessment team, the Transportation Security Administration Representative (TSAR) would arrange appropriate meetings and briefings. U.S. Interest Section representatives, host government representatives, and airport officials would be pre-briefed on what the assessment team would observe and how the information that is gathered would be used and safeguarded.

The assessment teams would use the minimum SARPs established by the ICAO's Annex 17 as a reference of measurement. The assessment would take roughly one week, depending on the size and complexity of the airport. The assessment team would be expected to directly observe the measures and processes involved in fulfilling the SARPs.

The results and observations of each assessment would be shared at an out-briefing with the Cuban government via the U.S. Interests Section. Then, using information provided by the assessment team, the Administrator would determine whether the assessed airport(s) implements and maintains effective security measures.

If no significant problems were noted, a letter would be sent to the Cuban government, through the U.S. Interests Section, summarizing the results of the assessment. Should the Administrator determine that effective security measures are *not* maintained at a particular airport, there would be several options available, depending upon the gravity of the situation.

include passenger and luggage screening.

2. Maritime

i. Port Operations

Repair and replacement of equipment is a key maritime infrastructure priority in Cuba. The main facility that handles containers is at the Port of Havana, which presently operates at 60 percent capacity or less. Additionally, the city of Havana faces congestion problems associated with state-sponsored development of the island's tourist industry.⁷

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Government should be prepared to analyze and advise a free Cuba on port privatization prospects recognizing possible complications associated with Castro-era expropriation policy.*
- *If requested by a transition government, the U.S. Government should be prepared to assist a free Cuba in identifying priority needs for port equipment and investments in port and intermodal infrastructure.*

ii. Intra-island Barge and U.S./Cuban Ferry Operations

An intra-island barge transport system could complement Cuba's inefficient land-based transport system, especially where the road system is deteriorated, inadequate, and congested. Cuba's waterways and numerous seaports provide a good foundation for freight movement by barges. The condition of any existing barges, however, is unknown. Although present low freight volumes do not justify barge movements, during a transition such capacity would be valuable to handle increasing freight volumes and emergency shipments.

⁷ The only gantry crane equipment seen in Cuba is located at the Port of Havana. The gantry cranes, many manufactured in Eastern Europe, can handle primarily 20-ft containers. The road system could possibly accommodate 40-ft containers but the trucking capacity is not known. There is no railroad equipment to accommodate 40-ft containers.

RECOMMENDATION:

- *Analyze and advise Cuban authorities on prospects for using intra-island barges to relieve Cuba's inefficient land-based transport system.*

For a regular short-sea shipping and/or ferry service with the state of Florida to be viable, a considerable volume would be needed to allow profitable operations. Cooperation with other modes, shippers, and forwarders would require logistics coordination, service level, frequency, and reliability for effective door-to-door transport.

RECOMMENDATIONS:

- *Facilitate expansion of existing U.S.-Cuban ferry service to transport passengers and cargo.*
- *Facilitate short-sea shipping opportunities for U.S. commercial interests involving operations between the United States, Cuba, and other Caribbean island nations.*

iii. Navigation Facilities

Navigation has historically been a vital component of Cuba's commerce and will play an even larger role in a free Cuba's commerce. Though the actual condition of Cuba's many ports is unknown, most are believed to be operating at some level. Immediate efforts could be directed to the staff at the Ministry of Transportation of a free Cuba and the Cuban Port Association to determine if depths at the major harbors are currently adequate for the ingress and egress of vessels, and the adequacy and accuracy of fixed navigation aids. Anecdotal evidence collected by the U.S. Coast Guard on authorized missions reveals that Cuban-reported depths are often unreliable. The immediate needs would only be focused on the major harbors and/or any bottlenecks in the system. Cuban capabilities will be assessed to determine if there are adequate in-house resources available, what contracting capabilities are either in place or available to support the Cubans, and whether or not new contracts need to be issued.⁸

⁸ A list of the major harbors is listed below:

Principal Harbors		
		Maximum Depth (meters)

RECOMMENDATION:

▪ *Conduct Navigation Facilities Evaluation*

An acquisition plan identifying various contracts for services related to Architects/Engineers (A/E) services, surveys, geotechnical and geographic information systems, and other related support will facilitate the

Harbor	Province	Entrance	Anchorage	Docks
Bahía Honda	Pinar del Río	8.8	11.8	9.1
Cabañas	Pinar del Río	6.7	6.4	6.4
Mariel	La Habana	10.0	9.1	9.1
La Habana	La Habana	13.1 ¹	10.0	12.8
Matanzas	Matanzas	185.0	27.4	10.3
Nuevitas	Camaguey	11.5	9.7	10.6
Puerto Padre	Las Tunas	8.2	7.9	7.9
Gibara	Holguín	14.3	7.0	3.9
Banes	Holguín	9.1	9.1	7.6
Nipe	Holguín	71.3	14.6	10.3
Guantánamo	Guantánamo	22.5	8.3	7.3
Santiago	Santiago	13.7	9.1	8.8
Cienfuegos	Cienfuegos	13.1	12.8	9.1

¹ Increased depth may be limited by highway tunnel

General: Initiation of efforts would be through the in-house Cuban workforce, existing construction and/or Architect/Engineer (A/E) contracts or the issuing of new contracts, if needed. Work would initially proceed with the assessment of the critical harbors and then move to the remaining principal harbors to determine their condition and needs for emergency actions, and to establish a process for rehabilitation. This initial effort would include surveys of the harbors and assessment of the piers, bulkheads and other marine and support structures. The above list of principal harbors provides a magnitude of the scope of the effort required. Known depths as currently reported in available literature are noted. As coordination is established with the Cubans within the framework of the overall development assistance plan, an order of work or priorities can be developed for the assessment of the harbors. The type of effort immediately needed includes the following:

- 1) **Hydrographic Surveys.** Establish the requirements for performing Multibeam surveys of harbors, to include docking areas, and supported by geo-referenced aerial photography as well as Lidar capability. The critical harbors could be surveyed within the initial two months.
- 1) **Geodetic Positioning Framework.** From the existing network in Cuba, confirm its location and accuracy for needed survey work.
- 1) **Geotechnical Studies.** Provide for capabilities for core borings and geophysical investigations in support of the structural assessment of facilities.

Reconnaissance Assessment of Facilities. Through the use of A/E contracts, perform a reconnaissance-level assessment of the critical harbors through the use of surveys, geotechnical studies and inspection of the docks, bulkheads, wharfs and marine facilities as to their structural integrity, maintenance and renewal and replacement needs. Establish a priority points process to rank the deficiencies and criticality of needs.

improvement of navigational facilities. Ideally, such a plan would identify more than one contract, which could include small firms with bilingual capabilities (Spanish and English), as well as emerging Cuban national firms from the current Ministry of Construction framework.

RECOMMENDATION:

- *Assist in development of an acquisition plan.*

3. Railroads⁹

Because published/available rail-related data and assessments of Cuba's rail system are either outdated and/or based on perfunctory observations, a critical requirement is to have a qualified U.S. team quickly perform an accurate system assessment to assist a free Cuba in restructuring and improving Cuba's railroads.

RECOMMENDATION:

- *If requested by a free Cuba, the U.S. Government could contract with a U.S. company specializing in rail system assessments to ascertain status of railroad bridges, culverts, track, and other critical rail-related infrastructure assets including rolling stock.*

⁹ Rail transportation has played an important part in Cuba's economy for many decades, with its railroad hauling primarily sugar and tobacco commodities. The overwhelming majority of the Cuban population has ready access to rail service.

Cuba's railroad, the *Union de Ferrocarriles de Cuba* (UFC), is operated as a fully integrated state enterprise by Cuba's Ministry of Transport. Current staffing remains high for the size and volume generated by this system.

Although the rail infrastructure is in need of maintenance, upgrading and/or modernization, a more critical need in the near term is the replacement of locomotives and other rolling stock.

Intermodal (rail/truck/maritime) traffic between Cuba and the U.S. will be vital to successfully transition the controlled economy to a free market-driven economy. Such economic transition must occur quickly and effectively in order to achieve efficient, on-time delivery of services to potential customers, both in the U.S. and Cuba. Furthermore, container traffic moved by rail to distribution centers and/or the end customer is vital for the UFC itself to become profitable.

Currently, rail access to/from ports appears to be haphazard. Access to piers often is nonexistent, inadequate, e.g., one rail spur only, or in need of maintenance and repairs. Since intermodal traffic would be a major key to economic success in a free Cuba, every effort should be made early on to focus on improving rail access to/from ports.

4. Highways

i. Provide Staff Expertise

This work could include detailed analyses of key processes to identify administrative and procedural problems, conflicts, and resolution of issues that may arise during various phases of the rebuilding effort; updating manuals in order to meet widely accepted international practices; developing integrated information systems; establishing project delivery timelines; and establishing a relationship between the Cuban Ministry of Transportation (CMOT) of a free Cuba and the U.S. DOT to facilitate the establishment of technology transfer centers.

RECOMMENDATION:

- *If requested by a free Cuban government, the U.S. Government could provide advisors to the Ministry for a 2-year period, with options to renew. They would assist Cuban officials with design, construction, and maintenance issues associated with primary and secondary roads and bridges, as described below.*

B. ENERGY INFRASTRUCTURE

Several factors have led to a serious deterioration of the Cuban energy infrastructure system, including lack of proper maintenance, use of inappropriate fuel, aging equipment, unsuitable spare parts, lack of system equilibrium, and the effects of blackouts. Some sources estimate Cuba's current real capacity at only 1,200 megawatts. In order to support a market economy, the infrastructure would need to be modernized to generate 3,900 megawatts. Because current sources provide only a fragmentary view of the current state of Cuban energy generation and distribution capabilities, a comprehensive on-site evaluation of the existing infrastructure will be essential to, *inter alia*, assess the 1) adequacy of electric power supply to meet critical needs, including potential need for emergency generators; 2) adequacy and reliability of oil and natural gas supply sources, both domestic and foreign; and 3) adequacy and status of the electricity transmission and distribution network, crude oil and product pipelines and refinery facilities, and natural gas pipelines and distribution network.

RECOMMENDATION:

- *Work with officials of a free Cuban government to perform a comprehensive assessment of energy sector needs, priorities, and acquisition planning.*

Once a transition is underway and Cuba begins operating under a new, market-oriented philosophy, the country will require significant increases in energy supply for transportation, to provide tourism-related services, increase production of cement and other construction materials, boost production of numerous industrial and primary goods, and support the mining industry.

RECOMMENDATIONS:

- *Oil and Gas: In coordination with and subject to the desires of a free Cuban government, assess the adequacy and reliability of oil and natural gas supply sources, both domestic and foreign. In concert with a free Cuban government, identify funding needs and assist in providing or coordinating access to financing. In the gas sector, secure supply for power generation use and to industries that have converted to natural gas use.*
- *Refining: Again in coordination with Cuban authorities, assess the condition of the refining infrastructure and evaluate investment needs. Cuban officials will need to guarantee supply of adequate crude for processing, which would likely require financing guarantees.*
- *Electricity: Working with a free Cuban government, assess the adequacy of the electric power supply to meet critical needs and assess the need for new generating facilities, transmission lines, and substations. Provide access to financing and continue investments to expand power generation capacity. The U.S. Government should encourage a free Cuba to incorporate modular units to increase electricity supply to major cities without relying on major transmission grids and maintain local distribution grids. Guarantee electrical supply to water utilities.*
- *Nuclear: After coordination with free Cuban officials, assess radioactive materials in Cuba and determine which facilities require decontamination and decommissioning (D&D).*

- *Renewable Energy and Energy Efficiency: Subject to the desires of a free Cuban government, encourage or assist in a complete assessment of potential renewable energy resources (wind, hydropower, solar, biomass).*

C. WATER RESOURCES INFRASTRUCTURE

It will be productive to assess the capability and status of the Cuban ministry and individuals who previously had responsibility in the water-resources field. Those engineers and scientists are vital resources for providing historical knowledge and identifying critical needs.

1. Safety of Dams

U.S. sources should help Cuban technical staff to identify any critical dam safety issues. The inspections would assess the condition of the dams, identify urgent corrective measures, define needs for additional studies, scope and estimate cost of repairs and improvements, and evaluate the operations and maintenance schedule of each structure. Dam repair and rehabilitation is often very expensive and funding should be programmed to address critical issues quickly.

2. Drinking Water Quality and Wastewater Assessment

There may be a need for a rapid assessment of immediate equipment needs to ensure that drinking water systems are operational and chemicals needed to treat the water are available. Functioning drinking water treatment facilities would need to be optimized to ensure the highest quality of drinking water possible using existing facilities.

RECOMMENDATION:

- *If requested by a transition government, assess existing plants to ensure that the population is receiving water that is clean and safe.*

Quality and quantity of source water are critical considerations in determining where to focus triage efforts. An ample quantity of raw supply, regardless of any inadequacies of the treatment and distribution

infrastructure, can keep pressure in the distribution system to prevent continual recontamination of pipes.

RECOMMENDATION:

- *Offer technical assistance to develop a coordinated program of capital rehabilitation of the distribution system and distribution to end users of home water disinfection chemicals (i.e., sodium hypo chlorite as used in many developing nations).*

Specifics of Cuba's water supply system are not known, but the lack of safe and adequate potable water is common throughout Latin America. A report by CEPIS,¹⁰ "Assessment of Drinking Water and Sanitation 2000 in the Americas, PAHO, Sept. 2001" indicated that only 62 percent of Cubans have reasonable access to disinfected water. The inspection of existing water treatment plants should be a high priority. It is reasonable to assume that more capacity would be needed and/or the effluent quality would not be up to standards considered safe in the United States. Therefore, rehabilitation and expansion of treatment plants would likely be an immediate need.

RECOMMENDATIONS:

- *Offer assistance to assess the extent of any potential contamination of drinking water sources and address need to eliminate the source of pollution or install advanced treatment to address the contaminant of concern.*
- *Develop recommendations for equipment renewal and expansion.*
- *In concert with Cuban authorities, develop and put in place appropriate quality control and assurance for the treatment processes.*

¹⁰ CEPIS is the Spanish acronym for Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS), a regional center of the Pan American Health Organization (PAHO).

IV. MEDIUM- and LONG-TERM ACTIONS

A. REGIONAL PLANNING COUNCILS

Many of the infrastructure improvements described in this chapter transcend municipal or provincial boundaries. Improvements to water and sewage systems, highways, public transportation, and the electrical grid, for example, would demand large-scale improvements and investments simply to modernize infrastructure that is overburdened and that has suffered years of deferred maintenance. Cuba had a history of regional planning predating the Castro revolution, which could prove useful in a transition scenario.

The World Bank and the Inter-American Development Bank could potentially provide some of the funding. The necessary funding, however, would likely not all come at once. This would require free Cuban authorities to make difficult decisions, including regarding phasing. The areas that receive infrastructure improvements first would likely be the areas that also redevelop first; therefore, choosing the areas that receive infrastructure improvements would have a huge economic impact on the regional economy. Regional planning efforts in other cities such as Cienfuegos and Santiago could also help improve job access in those regions, which have suffered under the Castro government, and create a better atmosphere for economic development.

In the United States, municipalities frequently create capital improvement plans for five or ten years in order to select and phase necessary infrastructure projects. In a free Cuban context, regional planning councils could help prioritize projects and the phasing of large, multi-year infrastructure improvements. Development would follow infrastructure, so selected projects would spur economic development in selected neighbourhoods. A capital improvements plan with recommendations from engineers and planning professionals, with public input, and selected by elected officials, would help create an orderly yet open and democratic system for needed infrastructure improvements. An open process at the regional level would also help foster citizen participation and the development of local democratic institutions.

RECOMMENDATION:

- *The Department of Housing and Urban Development and organizations such as the National Association of Regional Councils (NARC) can assist a free Cuba in the development of a regional planning approach that includes elected officials, planning professionals, and the public. Regional cooperation would help develop common strategies that also efficiently use available funds for issues that transcend simple political boundaries but are more reflective of the regional economy.*

B. TRANSPORTATION

1. Aviation

An efficient air transportation system is a critical element of infrastructure that would facilitate the development of tourism, employment, and overall economic development in a post-Castro Cuba. It is unrealistic to expect that Cuba will be able to handle the anticipated immediate and substantial increase in user demand that may occur when Cuba is free. In particular, the rapid expansion of the Cuban air transport system would lay the foundation for Cuba to re-establish aviation relations with the U.S. and, in turn, assist in the growth of an efficient, market-based international economy with exponential potential for increasing commercial and business exchanges, investment, exports, and tourism. Depending on a number of variables, air passenger traffic between Cuba and the United States is likely to grow in a transition scenario.

i. International Air Services Agreements

Upon initial resumption of air services with Cuba on the basis of comity and reciprocity, in addition to rights under the 1953 bilateral aviation agreement, the U.S. Government should seek negotiation of a bilateral air services agreement on Open Skies principles. Open Skies air transport agreements enhance aviation relations by allowing airlines to make commercial decisions with minimal government intervention. They provide for open routes, capacity, frequencies, designations, and pricing, as well as opportunities for cooperative marketing arrangements, including code sharing. A liberal regime would offer Cuba the best environment for developing its markets to attract additional air services for the benefit of travelers, shippers, tourism, and the broader economies of both countries.

It is U.S. policy to pursue liberal, market-oriented Open Skies agreements with virtually all nations that are willing to make the commitment. Since 1992, the U.S. has reached bilateral Open Skies agreements with more than sixty partners throughout the world. Our partners include countries at all levels of economic development. The United States should also encourage Cuba to adopt a liberal aviation framework with its international partners.

RECOMMENDATION:

- *The United States could assist Cuba in developing a liberal international aviation policy. Bilaterally, the United States should negotiate a new aviation agreement with Cuba on Open Skies principles.*

ii. Organizational/Governance Structure

a. Institute of Civil Aeronautics of Cuba

The Institute of Civil Aeronautics of Cuba (IACC) is the government organization responsible for regulating and maintaining civil aviation safety oversight for Cuba, and for providing air traffic/air navigation services. The IACC also has oversight responsibilities for the airport system and is responsible for the inspection and certification of airports.

b. *Empresa Cubana de Aeropuertos Sociedad Anónima*

The *Empresa Cubana de Aeropuertos Sociedad Anónima* (ECASA) handles overall management and operation of Cuba's airport system. In addition to the airports, ECASA operates four airlines, in-flight catering operations, ground operations, and other service companies.¹¹

Cuba is one of the original members of the International Civil Aviation Organization (ICAO) of the United Nations and is currently a member of the ICAO Council. Cuba is also a member of the Latin American Commission for Civil Aviation (LACAC), a regional organization that meets to discuss and plan required measures for cooperation and coordination of regional civil aviation activities.

¹¹ U.S.-Cuba Trade and Economic Council, Inc., "Economic Eye on Cuba," December 20, 1998.

iii. Current State of Aviation Infrastructure

a. Cuban Air Carriers

The quality and condition of the island's aviation infrastructure will dictate how readily a free Cuba could adapt to forecasted increases in air travel expected once U.S.-Cuban relations normalize.

b. Cuban Air Carriers (International)

Cubana Airlines is the government-owned air carrier, which is part of the IACC. An aging fleet led to a string of accidents in 1990s and to a dubious distinction of being identified as one of the worst airlines in the world in 1999. Since then, the Cuban government has purchased a new Airbus 320 and 330, and an IL-62 for international flights, has leased a used DC-10 through a French airline (AOM), and has continued to use aging Russian aircraft (YAK- 42 and AN-24) for domestic flights and cargo flights on Cabaña Cargo. According to IATA statistics, Cubana carried 598,800 passengers internationally on 5,284 flights in 2000.¹² Aircraft from 62 foreign airlines (mainly from Europe) arrived in Cuban airports last year.¹³

Aero Caribbean Airlines is a small regional commuter airline with routes to Santo Domingo, Managua, Nassau, Freeport, Port au Prince, Montego Bay, and Grand Cayman. Its fleet consists of Antonov An-26s, ATR 42-300s, Ilyushin Il-18Ds, and Yakovlev Yak-40s.¹⁴

c. Cuban Airport Operations

The Cuban government has developed an extensive network of airfields to provide aviation services throughout the island nation. *Empresa Cubana de Aeropuertos Sociedad Anónima* (ECASA) is responsible for the overall management and operation of Cuba's airport system. The IACC maintains oversight responsibilities for the airport system and is responsible for the certification process for airport operations.

Several airports maintain runways, aprons, and parking areas that can accommodate large commercial transport aircraft. The airports vary in terms

¹² Cubana web-site www.cubana.cu/ingles

¹³ Center for Promotion of Investment in Cuba web-site www.cpi-minvec.cu

¹⁴ caribbeanaviation.com/airlines; nashtravel.com/aerocaribbean.com

of available services and general condition. Five cities — Camaguey, Havana, Holguín, Santiago, and Varadero — operate airports with runways that are more than 10,000 feet in length. The two longest runways in the country are found at Havana's José Martí International Airport and Santiago's Antonio Maceo International Airport. Both airports operate runways of approximately 13,100 feet, which can accommodate the largest wide body aircraft on the market today.

Major Airports in Cuba Used for Commercial Aviation Operations				
City	Airports	Elevation (ft.)	Longest Runway Length (ft.)	Runway Width (ft.)
Camaguey	Ignacio Agramonte International	413	9,842	180
Cienfuegos	Jaime González	100	7,874	135
Havana	José Martí International	210	13,123	148
Holguín	Frank País	348	10,154	164
Santiago	Antonio Maceo Intl	225	13,123	148
Varadero	Juan G. Gómez Intl	213	11,483	160

Source: Defense Intelligence Agency Report – November 1998

The CIA World Factbook reports that Cuba had 161 airports in 2002. Approximately 70 of these airports operate with paved runways. Of this total, seven reportedly operate runways longer than 9,900 feet, which can accommodate most large commercial jet aircraft. Another 10 airfields have paved runways between 7,996 and 9,900 feet. Most of these airports can also handle large commercial jet and turboprop aircraft.

1) Conditions of Airport Facilities

Limited official information is available on the current condition of airport terminals, buildings, runways, and emergency services. Given its economic reliance on tourism, the Cuban government has invested in upgrading airport terminals in the principal tourism locations since the mid-1990s.¹⁵ Most airports have adequate fuel and cargo handling equipment, as well as air traffic control equipment for managing movements of civil

¹⁵ Among others, the airports in Havana, Santiago, Varadero and Cayo Coco have new terminals and facilities. The Cuban government has worked primarily with European and Canadian organizations on the upgrades.

aircraft. Maintenance facilities are also available at the larger airports. In addition, Airport Rescue and Firefighting (ARFF) equipment is available at larger airfields, although the condition of the equipment is not known.¹⁶

Excessive vegetation growing near and around airport runways is a common problem in Cuba. In particular, tree encroachment is reported as a problem for the safety of aviation operations at several airfields.

2) NAVAIDS

The amount and sophistication of air traffic control equipment available to support aviation operations varies among airports. Advanced radars and navigation aids are available at several major airports, though their operational integrity is not known. Most radar systems are airport surveillance radar (ASR) systems, which typically have ranges of between 50 and 60 miles. International airports typically have approach control supported through air/ground radio systems, instrument landing systems (ILS), and non-directional beacons (NDB).¹⁷

d. Air Traffic Management/Airway Facilities

1) Current U.S.-Cuban Air Traffic Environment

Proximity and operational necessity have fostered a working relationship between the United States and Cuba on air traffic procedures and operations. The Federal Aviation Administration's (FAA) Miami Air Route Traffic Control Center (ARTCC) and the Havana Air Traffic Control Center (ACC) communicate daily to transfer control of aircraft across the common Flight Information Region (FIR) boundary, through which much of the traffic passes en route between the U.S./Canada and the Caribbean, Central and South America.¹⁸

A significant amount of en route traffic between the U.S. and Latin America/Caribbean passes through the Cuban FIR, due to its size and location 90 miles off the coast of Florida. The volume of this traffic that flies over Cuba has increased in recent years by an average of more than 3

¹⁶ Sources: Defense Intelligence Agency Report – November 1998; Joint Theater Transportation Study, DI-2000-187-99

¹⁷ Ibid.

¹⁸ The United Nations International Civil Aviation Organization (ICAO) determines FIR boundaries.

percent per year, for a total of 48 percent since 1990. In 1990, the Havana ACC handled approximately 300 aircraft operations per day. In 2004, the number has grown to approximately 560 operations per day.¹⁹ This upward trend is expected to continue for the foreseeable future. Air traffic into Cuba's seven principal international airports²⁰ is mostly conducted by chartered aircraft and European, Canadian, Mexican, and Caribbean commercial carriers.²¹ According to the "Country Infrastructure Brief" by Cuba Caribbean Consulting of Miami, air transportation within Cuba is somewhat limited due to a shortage of available aircraft.²²

The Miami ARTCC and the Havana ACC coordinate transfer of control for more than 500 aircraft in four of the five approved radar sectors on a daily basis.²³ There are two direct voice circuits ("hot" phone lines that are voice activated) used to coordinate information on aircraft entering each country's airspace. In addition, controllers use seven MEVA Network dial lines to place direct calls between the Centers and one Aeronautical Fixed Telecommunications Network (AFTN) circuit for transmitting aircraft flight plans (including departure times and estimated time of arrival at the FIR boundary) to the receiving facility.

2) Air Traffic Control System in Cuba

The Cuban Air Traffic Control (ATC) system is relatively modern for a country with limited resources, a reflection of the government's interest in encouraging tourism. Cuba has full radar coverage over its flight area, with multiple radar sites. Most of the ATC equipment is Canadian and French. The Air Traffic Control Center (ACC) located on the grounds of the José Martí International Airport in Havana handles all en route flight service for the island. In addition, the Havana ACC controls the approach (landing and take off) for all Cuban airports that conduct Instrument Landing System (ILS) or other Instrument Flight Rule (IFR) approaches. It is a dual-use

¹⁹ Statistics from FAA Miami Air Traffic Control Center and Cuban IACC website.

²⁰ The seven principal international airports are Havana, Varadero, Camaguey, Santiago de Cuba, Holguin, Cienfuegos, and Cayo Largo del Sur.

²¹ U.S. carriers that provide authorized charter service to Cuba are American Eagle, Continental (Gulfstream), Delta (Marazul Tours), United, Falcon Air, Golden Air, and Miami Air. Most fly to Havana, but service is also offered to Camaguey, Cienfuegos, Holguin, Santiago, and Varadero.

²² Country Infrastructure Brief, Report No. IF-06-98, CubaCaribbean Consulting (formerly Development Co.), 2001

²³ Along the 11 approved north bound and south bound routes

facility, with three en route air traffic sectors, the approach to José Martí, and one military operations sector.²⁴

The Havana Center is similar in size to a small U.S. approach facility such as that located in Ft. Myers, Florida, but with the additional responsibilities of an en route center. Any aircraft that flies through (overflies) Cuban airspace is assessed an overflight fee for use of the air navigation services. Overflight fees generate a significant amount of revenue for the Cuban government, given Cuba's advantageous position as a direct route between the eastern U.S./Canada and Latin American/Caribbean air travel. The Havana ACC has a dedicated position to track and record overflight aircraft.

In 2003, the IACC completed construction on a newly renovated ACC building on the José Martí airport surface in Havana. The new center, designed and built by INTELCAN Technosystems, Inc. of Canada, is purported to have a modern automated Air Traffic Management (ATM) system with Voice Communications Control Switching, Radar Processing and display, Flight Data Processing, Air Traffic Network Message Switching, VHF Ground to Air radios, an intercom and recording systems, and a nationwide Data Telecommunications Network.²⁵ The ACC uses off-the-shelf computers and monitors, with an advanced ATM software package customized to meet the operational requirements of the Havana ACC. INTELCAN maintains that the software has been designed to allow for a seamless transition to a new satellite-based Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) environment, which Cuba expects to move to over the next few years.²⁶

Separation standards in Cuban airspace are greater than those applied in the U.S. Havana ACC maintains a minimum of 10 nautical miles between aircraft horizontally, rather than the five or three miles in the United States.

²⁴ For the purposes of this report we will focus on civilian operations exclusively.

²⁵ INTELCAN Technosystems Inc. Project Experience website. The FAA has not yet seen the new facility; the next bilateral air traffic operations meeting is scheduled to take place in Havana in July 2004.

²⁶ Ibid; the Miami ARTCC confirms that the Cuban controllers have not yet moved into the new facility, pending completion of training on the new equipment.

3) Cuban Air Traffic Controllers

The FAA has a working relationship with the Cuban Air Traffic Controllers in Havana. Although most air traffic controllers are civilians, the Cuban ATC system functions much like a military organization. The controllers wear uniforms and generally work 10-12 hour shifts.

4) Safety Oversight - Organizational/Governance Structure

Safety Oversight/Flight Standards issues will be among the most complex, most time consuming, and potentially most costly to resolve in an environment with the expected dramatic increases in air traffic. Pressure on the IACC to increase operations to meet expected demand (both arriving and departing Cuba) may be far beyond current capabilities.

5) ICAO Audit of the Cuban IACC

In June 2000, ICAO issued a summary report of its November 29 – December 6, 1999 audit of the Institute of Civil Aeronautics of Cuba (IACC) under the ICAO Universal Safety Oversight Audit Program (USOAP). ICAO audits all member states under the USOAP. The purpose of the USOAP visit was to determine the IACC's level of compliance with the ICAO Standards and Recommended Practices (SARPs) in the area of safety oversight.²⁷ This was a follow up visit to the initial USOAP carried out in 1996. The USOAP team found Cuba's level of compliance to be "essentially satisfactory,"²⁸ but noted a number of findings that did not meet the SARPs. Again reflecting the government's interest in encouraging tourism, Cuba subsequently submitted an action plan to address the findings and recommendations from the interim audit report. The Safety Oversight Audit section of ICAO considered the plan to be adequate. Since then, however, there have been no follow up audits to ensure that the action plan has been completed and that the IACC is meeting minimum ICAO standards. It is important to note that findings from USOAP reports do not satisfy FAA requirements to verify the adequacy of safety oversight capabilities of foreign civil aviation authorities from countries with service to the United States.

²⁷ USOAP audits are based on ICAO Annexes 1, 6, and 8 of the Chicago Convention and associated guidance material. Cuba, as a signatory to the Chicago Convention, which established ICAO in 1944, has pledged to meet minimum safety standards and recommendations established by ICAO.

²⁸ ICAO USOAP Summary Report, Audit of the Institute of Civil Aeronautics of Cuba, June 2000, p.2.

RECOMMENDATION:

- *The FAA should conduct a separate, more detailed assessment of the Cuban IACC.*

6) FAA International Aviation Safety Assessment (IASA) Program

The FAA has a statutory mandate to ensure the safe operation of foreign aircraft operating in U.S. airspace. The FAA's International Aviation Safety Assessment (IASA) program seeks to ensure safety by verifying that foreign civil aviation authorities are in compliance with the international safety oversight SARPs established by ICAO.²⁹ The IASA program goes into greater detail than USOAP, and, unlike ICAO findings, an IASA finding of non-compliance carries consequences, which provides an incentive to correct deficiencies or face restricted or denied service to the United States.

RECOMMENDATION:

- *The FAA should conduct an IASA of the IACC.*

7) Bilateral Agreement and Economic Authority

The U.S. Departments of State and Transportation (DOT) would seek to negotiate a new bilateral air services agreement with Cuba to replace the existing 1953 bilateral agreement. Once an acceptable agreement is in place between the two governments, the airlines would need to apply to DOT for economic authority to fly to the United States.

RECOMMENDATION:

- *The U.S. Departments of State, Transportation (DOT), and Commerce (DOC) would seek to negotiate a new bilateral air services agreement with a free Cuba on the basis of Open Skies principles, to replace the existing bilateral agreement dating from 1953. Pending completion of a bilateral air services negotiation, the two governments could allow a range of air services operations to resume on the basis of comity and*

²⁹ The establishment of the FAA's IASA program led to the development of the ICAO USOAP program.

reciprocity, in addition to the rights dating from the 1953 bilateral air agreement. FAA and TSA regulatory requirements would also have to be met before service can commence, and DOT would need to grant economic authority to carriers.

8) IASA and the TSA Security Assessment

The application for economic authority filed with DOT will trigger an automatic IASA of Cuba. A team of FAA aviation safety inspectors would travel to Cuba to assess the government's compliance with ICAO standards in Annexes 1, 6, and 8.

Before Cuban airlines could begin service to the United States, the Transportation Security Administration (TSA) requires a security assessment. TSA assesses the airport(s) that would serve as the last point of departure before arriving in the United States. After these assessments are successfully completed, the airline would need to work with the FAA to obtain an air carrier certificate and Operations Specifications for approved U.S. routes.

iv. Identified Infrastructure Development Needs and U.S. Assistance

a. Safety Oversight - Organizational/Governance Structure

While the ICAO USOAP report found that the IACC complies with most of the ICAO standards and recommended practices for safety oversight, concerns remain over other outstanding findings cited in the USOAP reports. Other safety concerns relate to the aging Cuban aircraft fleet, the dearth of manufacturing support for some of the Soviet models, and the limited resources for proper maintenance of equipment and training of personnel. In addition, conflict of interest issues will likely arise as a result of the Cuban government's position as both the owner and regulator of the country's air carriers. All of these factors contribute to the need for a full FAA IASA as soon as politically feasible.

1) Technical Review to determine compliance with ICAO standards.

RECOMMENDATION:

- *The FAA could work with the IACC to evaluate its compliance with ICAO SARPs in maintenance facilities and procedures, fueling facilities and procedures, and ground handling of aircraft in Cuba.*

2) Provide guidance on any needed changes to the eight critical elements of safety oversight in accordance with ICAO standards.

RECOMMENDATION:

- *The U.S. Government could assign a team of safety experts to work with Cuban IACC officials on the correction of any deficiencies in the eight ICAO Critical Elements of a Safety Oversight System, and the development of an action plan to achieve compliance. The FAA could also offer guidance on the process of certifying airlines, as well as approving maintenance and repair facilities.*

3) Operations/Airworthiness/Cabin Safety Inspector Training

RECOMMENDATION:

- *Based on the results of the recommended technical review, the FAA should be prepared to offer reimbursable, in-country inspector training in operations, airworthiness, and cabin safety inspection as needed.*

b. Airport Operations

1) Technical Evaluation for compliance with ICAO standards

See page 260, Safety Oversight

2) Technical Assistance/Training

Capacity-Building Assessment

Cuba may need to expand airport capacity to meet the expected demand for aviation services. Capacity constraints at existing airports may

actually limit the ability of U.S. and Cuban air traffic service providers to take full advantage of new procedures that would be implemented to accommodate the increased demand for air travel.

RECOMMENDATION:

- *The FAA can arrange for capacity building assessments of the major international airports for increases in both passenger and cargo traffic. These assessments would focus on the impact of increased aviation traffic on the airports and develop a strategic plan through which those airports could accommodate increased traffic through additional runways and/or taxiways, etc.*

Critical Airports Assessment

An in-depth evaluation would require approximately 12 months, given the large number of airports with paved runways in Cuba. This study would focus only on those airfields with paved runways.

RECOMMENDATION:

- *If agreed by both countries, the FAA could also arrange for an evaluation of the entire Cuban airport system to determine which airports are critical to the future of the overall system and which are superfluous. In addition to passenger traffic, the study would evaluate the requirements for accommodating expected increases in general aviation and cargo activity.*

Certification/Inspection Program Assistance

RECOMMENDATIONS:

- *The FAA would propose a follow-up visit to evaluate Cuba's Airport Certification/Inspection Program initiated in 1999 to verify its compliance with ICAO Safety Standards and the ICAO Manual for Airport Certification. FAA airport safety certification specialists would conduct meetings and interviews with government agencies and airport operators to determine legislation and programs in place to certify and inspect airports. The FAA inspectors would prepare a comprehensive report within 90 days of the visit to document existing airport*

certification and inspection programs and any areas where improvements would be necessary.

- *The FAA has an Airport Certification Inspection course based on ICAO requirements and recommended practices that could be taught in Cuba to airport safety inspectors. In addition, the FAA would offer guidance to the senior airport officials at the IACC on the management of a successful airport certification program.*

3) Aircraft Rescue and Firefighting (ARFF) Capabilities

RECOMMENDATION:

- *The FAA has Aircraft Rescue and Firefighting (ARFF) experts who could conduct thorough analyses of the ARFF capabilities at the principal international airports in Cuba. Using ICAO SARPs and related guidance material, the FAA ARFF team would identify areas where improvements are needed to be ICAO compliant.*

4) Emergency/Contingency Planning Assistance

RECOMMENDATION:

- *Based on the needs identified in the FAA's initial Technical Evaluation for ICAO Compliance, the FAA could offer emergency and contingency planning assistance to each of the principal airports with international operations.*

c. Air Traffic Management

The demand for air travel to and from Cuba is expected to increase dramatically when the U.S. travel restrictions to a free Cuba are lifted. This increase in aviation activity will have an impact on air traffic services (ATS) in both the U.S. and a free Cuba.

In addition to anticipated increases in passenger and major carrier activity, the FAA foresees a proliferation of small carriers interested in providing service to and from Cuba and substantial increases in general aviation (small/private or business planes). Significant and sustained increases in air cargo are expected as U.S. companies and government

agencies seek to assist in meeting the long-standing needs of the Cuban people.

The following is a survey of the areas in which the U.S. Government could offer assistance to a free Cuba in the areas of Air Navigation Services (ANS) (including air traffic management and efficiency) and ANS Infrastructure (including communications, navigation, and surveillance).

1) Improve Air Traffic Flow Management and Operational Procedures (e.g., coordination and transfer of control)

RECOMMENDATION:

- *The FAA should encourage a free Cuba to establish a liaison at the Miami ARTCC facility to facilitate coordination in the new air traffic environment.*

2) Automation Systems Interfaces

RECOMMENDATION:

- *The FAA and IACC should investigate a means of interfacing their flight data and radar data processors, allowing for automated data exchanges. This will increase controller flexibility and system capacity to help meet the projected increase in traffic.*

3) Restructure Radar Sectors

RECOMMENDATION:

- *If mutually agreed upon, the FAA can arrange a capacity building analysis of radar sectors within the Havana ACC and provide recommendations for improvements.*

4) Assist with the adoption and use of basic Global Positioning System (GPS) in Cuban airspace

Cuba is currently working with Europe on global navigation satellite systems.

RECOMMENDATION:

- *The U.S. Government should explore the capabilities that the U.S. GPS Augmentation System might provide to Cuba.*

5) Controller Training

Cuban air traffic controllers can handle the current air traffic volume in Cuba. With a potential normalization of relations between the United States and a free Cuba and the anticipated increase in traffic that would likely follow, a free Cuba may need additional controllers and training to meet the increased volume.

RECOMMENDATION:

- *The U.S. Government should be prepared to offer technical assistance to Cuban controllers to deal with the expected increase in flights and training for any additional controllers needed.*

6) Liberalization of International Air Agreements with the U.S. and others

It is advisable to pursue an Open Skies bilateral air transport agreement with a free Cuba. If necessary, such an agreement could include phased-in provisions. Cuban air carriers, after some 50 years of government control, are not likely to be operationally or financially capable of competing with deregulated and more efficient U.S. carriers in an immediately open-market environment. Moreover, it is unlikely that Cuban aviation and tourism facilities will be able to handle an immediate and substantial increase in user demand. Phased-in provisions will allow time for Cuban infrastructure development. An Open Skies agreement would provide a basis for each country's airlines to enter into cooperative marketing arrangements, including code-sharing operations with other airlines and with surface transportation providers. These agreements would be beneficial to U.S. and Cuban carriers.

RECOMMENDATION:

- *The U.S. Government should pursue an Open Skies bilateral agreement and also support Cuba's effort to liberalize aviation relations with third countries.*

2. Maritime

Cuba's maritime transport system of waterways, ports, and intermodal connections played a dominant role in Cuba's early settlement and growth. As an island state, Cuba depends heavily on marine transport for trade and commerce, and thus, the well-being of its people. However, the Cuban marine transport system, like other parts of its national transport infrastructure, has been in a state of long-term deterioration due to a persistent lack of maintenance and supply of equipment.

Cuba's extensive coastline can help stimulate regional growth and economic development. To help Cuba take advantage of its geographic position and compete in a global trading environment, a robust marine transport system with efficient waterways and ports with links to rail, trucking, barge, and pipeline operations will be necessary. Low-cost barge transport growth could also complement Cuba's overall transport system by alleviating land-based transport congestion and thus increasing productivity.

Due to the importance of linkages between Cuba's maritime assets and other modes of transport on the island, the need to rapidly evolve intermodal aspects of its transport system is critical. To achieve a seamless global supply chain, dependence on technology and connectivity will become a high priority for a free Cuba as the volume of cargo increase. Additionally, if Cuba is to conform to the recent "24 hour manifest rule" mandated by U.S. Customs Service, investment in technology and training will also be required.

i. Organizational/Governance Structure

At present, the Cuban Ministry of Transportation (MITRANS) is the institution responsible for maritime civil transportation, including auxiliary and connective services. It administers, on behalf of the Cuban regime, an enterprise system composed of more than 250 public and private enterprises as well as joint ventures.

ii. Current State of Infrastructure

a. Main Ports and Facilities

The U.S. Business Council, with funding from the U.S. Agency for International Development (USAID), completed a study on “Ports of Cuba.” In 2001, The Cuba Caribbean Development Co. published the report “Ports of Cuba Report, IF-02-96,” that provides a comprehensive profile of strategic Cuban seaports, including accessibility, stage of development, transportation, and other potential trade and commerce issues. This section provides key characteristics of Cuba’s ports and does not revisit extensive and/or specific technical details that are already published.

Cuba, with 44,206 square miles, is the largest island in the Caribbean. Between the eastern and western extremities of the island, there is a distance of approximately 750 miles. Cuba’s coastline of approximately 2,200 miles has an extraordinarily large number of good harbors, among which are the bottlenecked harbors that have narrow entrances but commodious anchorage. The main harbors of this type are Bahia Honda, Cabanas, Mariel, Havana, Nuevitas, Puerto Padre, Nipe, and Tanamo on the north coast, and Guantanamo, Santiago de Cuba, and Cienfuegos on the south coast. The principal open harbors are Matanzas and Cardenas.



There are a total of 70 ports in Cuba. Ten of these can be categorized as major, including Havana (60 percent of all cargo), Matanzas, Santiago de Cuba, Cienfuegos, Nuevitas, Caibarien, Guantanamo, Cardenas, and Mariel.³⁰

³⁰ **Havana** - The container terminal of Havana Harbor (TCH S.A.) is a joint venture between Cuba and Spain started in 1998. It is the only one of its type in Cuba, due to its high technological specialization through a modern information network. The investments are currently addressing berthing and storage capacity, port handling equipment, and railway access.

Cienfuegos is the second largest port in the Caribbean. It is the marketing and processing center of a region producing sugarcane, tobacco, coffee, and rice; it also has rum distilleries and fish canneries. Cienfuegos as the capital of Cuba's most industrialized province, is a major hub of industry, commerce, and trade. With its expansive, deep bay, the city receives much of the shipping business for goods needed by other industrialized cities in the area. Cienfuegos has enough land for future development and could accommodate Post-Panamax vessels.

Matanzas is the third largest port with a large, deep harbor with deep oil terminal. Industries in the city include sugar refineries and textile mills. Matanzas is located on the turnpike between Havana and Varadero Beach. Matanzas is important for transshipment services to the Caribbean of bulk and bagged fertilizers. It is also linked to the national railway system. The port also operates the port of Cardenas that provides tourist ferry traffic to the province.

Cardenas lies in the Matanzas province. It processes and exports sugar and has industries producing tobacco, beer, and soap. A fishing fleet is based at Cardenas, which is also an important commercial center.

Nuevitas is sheltered by a huge harbor, has two auxiliary ports, and is a major shipping point for Cuban sugar as well as other products from the surrounding agricultural region. It also possesses diversified light industry and serves as a road and rail terminus. Ports handle about 6 percent of total sugar exports, serving 5 sugar mills from Camaguey and Ciego de Avila provinces, and have cargo facilities for bulk grain handling. Nearby are a thermoelectric plant, fertilizer and cement plants. It is connected to Camaguey city by railroad system and a 2-lane highway.

Mariel port has the greatest possibilities for development in the Western part of Cuba and at the same time it is very close to Havana. It is particularly interesting when evaluating new options of transshipment due to the fact that it is close to the main ports of North and Central America. The Port can handle general cargo and containers. The port equipment includes 5 shore cranes (10 to 20 tons capacity). Mariel free zone is considered an important logistics factor for future marketing development.

Santiago de Cuba is located in the eastern part of Cuba. Its geographic position in relation to the maritime lines that go to and from the Panama Canal, the Caribbean Sea and the north part of South America, give the port the potential to be a transshipment hub. Minerals, agricultural produce, and woods are exported. The city is also the terminus of a major highway and railway. One of Cuba's most comprehensive port facilities with a capacity of handling over 3,000,000 tons/2,721,000 metric tons of containers, bulk grain, or liquid cargo. Port facilities are good and able to handle bulk grains, liquids, and containers. The two thermoelectric plants and an oil refinery are the backbone of local and regional industry.

Guantanamo is on the Guaso River. It is the processing center for a sugar- and coffee-producing region and has road and rail connections with Santiago de Cuba. At **Guantanamo Bay**, the United States maintains an important naval station. The base has naval installations covering c.45 sq. mi (116 sq. km). Guantanamo Bay, as a Navy base, is not built for normal cargo operations, meaning the piers do not have large cranes like a commercial port (<http://www.msc.navy.mil/N00P/pressrel/press02/press02.htm>).

b. Container Facilities

The container terminal of Havana Harbor (TCH S.A.) is a 50-50 joint venture between Cuba and Spain, formed in 1998. TCH was originally budgeted for traffic of 180,000 TEU³¹/year being reached by the end of its 15-year concession (with a 5-year option) in 2013, but throughput reached 262,000 TEUs.³²

The facility has the technical ability to handle cargo with very modern, complex, fully outfitted equipment. However, Cuba's frequent blackouts make the entire system unreliable, as equipment and refrigeration units can not function without power. Also, the generators are old and break down regularly, and are a challenge to repair without skilled labor and easy access to replacement parts. In 2003, the port of Havana handled a total of about 300,000 TEUs a year.

c. Shipyards

Cuba has four shipyards located close to the City of Havana, Havana, Santiago de Cuba, and Cienfuegos, which are also specialized in naval repairing and constructing steel polyester and aluminum. There is also a naval engineering division that carries out related projects, repairs, supervision of naval construction, diagnosis, development of specialized plans, and maintenance systems. Shipyards in Santiago de Cuba are capitalized in association with Dutch companies.

d. Cruise terminals

Cuba's government-operated Cubanco S.A., a joint venture between the Cuban Ministry of Transportation and Silares Terminals del Caribe NV, currently operates cruise ship terminals at the port of Havana, the port of Santiago de Cuba and on the Isla de la Juventud. The company constructed a fourth passenger-ship terminal at the Cuban port of Cienfuegos.³³

³¹ The International Standards Organisation specifies standard shipping containers as 20 feet long by 8.5 feet square. These are the standard unit for measuring container throughput-one such standard container is 1 twenty-foot equivalent unit or 1 TEU.

³² <http://www.worldcargonews.com/htm/n20030201.424841.htm>

³³ www.cruisehavana.com/news01.html

e. Intermodal Connections

Intermodal transport is critical for Cuba's economy and expansion of foreign trade. Cuba, however, would need to develop sophisticated logistics and supply management expertise to integrate its transport system into customer-oriented, end-to-end services.

1) Current State of Intermodal Transport

Any development of intermodal transport would necessitate a level of normality in the transportation network before embarking into more sophisticated integrated networks. This process is hampered because Cuba's continuing economic crisis has dramatically slowed the pace of motorization while the Castro regime ensured that development has been tightly controlled. Particularly noticeable is how the modal share of motorized transport fell from 93 percent to about 43 percent (from 1962 to present), making Havana one of the most non-motorized cities in the world (57 percent modal share) just under Beijing, China (62 percent); Jaipur, India (66 percent); and Bobo Dioulasso, Burkina Faso (87 percent).

iii. Identified Infrastructure Development Needs and U.S. Assistance

a. Organizational/Governance Structure

Good governance provides an enabling environment for the expansion of trade and economic growth. Current transition strategies have increasingly recognized the importance of well-functioning social institutions as the necessary foundation of a well-functioning market economy. A free Cuba's transport and logistics integration into the Western Hemisphere will be an important strategic objective.

When a transition to a free Cuba takes place, additional investments would be needed for maritime connections, including a program to break up congestion around ferry ports (previously major entry points for American tourists) in order to accommodate the significant anticipated increase in economic and hence transport activity. A priority is to promote the rapid growth of export-oriented private business³⁴ enterprises and facilitate the

³⁴ Cuba Transition Project – Foreign Direct Investment by Robert David Cruz 2003

development of business management skills necessary for success in a globally integrated market economy.

RECOMMENDATION:

- *The U.S. Government should focus primarily on providing technical assistance, transferring knowledge and information, and promoting a multinational effort to provide the financing needed to rebuild transport infrastructure that promotes trade and economic development.*

b. Capital Improvement Needs - Port Assessments

A significant effort by new leaders to improve the marine transport system will be required to support the rapid growth of maritime commerce expected following a change in government on the island. A free Cuba may require assistance in developing a marine transport strategy to meet the present and future needs of Cuba's commercial and recreational users in the areas of public safety, efficient movement of cargo, and national security while facilitating recreation and environmental protection.

RECOMMENDATION:

- *The U.S. Department of Transportation should offer technical assistance in these areas.*

In the initial period of transition, it may be easier for large transnational firms to raise the capital necessary to build new ports or modernize existing ports than for a new Cuban government. Privatized ports may represent an option for developing much-needed infrastructure within a short time frame. Experience suggests that a regulatory structure that balances private and public interests is necessary in the case of privately owned and operated infrastructure.

RECOMMENDATION:

- *Encourage international financial institutions, such as the IMF, the World Bank, and the Inter-American Development Bank, as well as other governments and the private sector, to provide Cuba technical assistance to modernize its ports through capital improvement.*

c. Human Development Needs - Maritime Training

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Maritime Administration (MARAD) could send maritime experts from the U.S. Merchant Marine Academy (USMMA) to Cuba to provide training, or Cubans could be trained at the USMMA.*
- *Under the same conditions, MARAD, working with the Department of State, could develop a maritime education and training program in Cuba.*
- *Working with international aid organizations, the U.S. Government should encourage representatives of a free Cuba to attend the World Maritime University, located in Sweden and established by the International Maritime Organization (IMO). The university offers specialized postgraduate education in maritime transportation.*

d. Security and Safety of the Marine Transportation System

Cuba is a party to the basic International Maritime Organization (IMO) conventions and protocols to improve maritime safety and protection of the maritime environment, including SOLAS, COLREGS, MARPOL, the Load Lines Convention of 1966, STCW, the Facilitation Convention of 1965, Inmarsat Convention of 1976, and the Intervention Convention of 1969. Notably, Cuba is not a party to the SOLAS Protocol of 1988, the Load Lines Protocol of 1988, the amendments to Inmarsat, the Intervention Protocol of 1973, the OPRC Convention of 1990, or any of the liability agreements.

Cuba appears to be an active member of the Viña Del Mar Agreement, an agreement of nine Latin American states to address Port State Control (PSC) of Vessels, that implements port state control inspections in support of IMO treaties and protocols. However, shipmaster's reports from the guide reference no PSC type inspections and examinations by Cuban officials to determine compliance with international safety, security, and environmental standards aboard visiting commercial vessels. The lack of information regarding the quality, degree of intrusiveness, and technical acumen of Cuban PSC boarding teams leaves uncertainty regarding the capability of Cuban maritime safety officials in this area. Comments on

examinations reported by masters in the guide were limited to issues related to Customs (including sealing of valuables in a transit room and accounting for currency), crew identification (sometimes including full musters), veterinary victuals (including sealing of meats, milk, cheese, poultry, and fish products not sourced from U.S., Australia, Canada, and New Zealand), sanitary and certificate review (including collection of copies of all required documents and forms). Thorough inspection by Border Guards, often with dogs, are conducted of all man-sized spaces prior to a vessel's departure after all other Cuban port authorities are ashore (searches are often conducted along with crew musters).

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Coast Guard (USCG) could provide support to a transition government through an existing International Training Program. Under this program, the Coast Guard provides training to officers, enlisted, and civilian personnel from foreign military and civilian agencies when USCG operational and training requirements permit, in compliance with applicable laws and authorities.*
- *The Coast Guard could deploy mobile education and training teams (MET/MTTs) to provide training in all mission areas. In addition, Cuba may desire, and the United States may wish to provide, Coast Guard resident training and support from the Caribbean Support Tender after the emergency phases are complete.*

e. Privatization / Commercialization Prospects

Like ports in other Latin American nations, it is anticipated that Cuba's largest and most important investments will come from the private sector with assistance from institutions such as Inter-American Development Bank (IDB) and the World Bank. Most of these investments will be made for privatization of state-owned assets, and will come from private companies with specific objectives and from capital markets. Cuba's close proximity to the United States, its underdevelopment and plentiful mineral resources, its educated work force, its top-rated natural attractions, as well as other characteristics, have a positive impact on potential foreign investors.

RECOMMENDATION:

- *The U.S. Government, through its industrial base (private port industry and manufacturing) and the international institutions, including the World Bank and the Inter-American Development Bank, could assist in a free Cuba's privatization of its port industry.*

f. Navigation Facilities

Intermediate and long-term efforts should focus on strategic planning to both rehabilitate and enhance the country's navigation system. In concert with a free Cuba's Ministry of Transportation and Port Association, navigation modeling should be performed to analyze current and project navigation needs. The modeling results will allow informed, strategic decisions to be made about future navigation investments.

RECOMMENDATIONS:

- *The U.S. Army Corps of Engineers could provide state-of-the-art computer models and training if needed.*
- *If requested by a transition government, the U. S. Coast Guard could provide:*
 - *technical assistance in determining correct mix of Aids to Navigation (A-to-N);*
 - *technical assistance in revising, updating, and identifying needs in Marine Information area;*
 - *technical assistance in assisting in development or modification of A-to-N units; and*
 - *technical assistance in any potential improvements to their training infrastructure to accomplish the A-to-N mission, either through establishing in-house capabilities or through resident or deployable training teams.*

3. Railroads

i. Introduction

a. Importance of Railroads to Cuban National Economic Development

The overwhelming majority of the Cuban population has ready access to rail service. Rail transportation has played an important part in Cuba's economy for many decades, hauling primarily sugar and tobacco commodities. Rail passenger transportation has been equally important, particularly during the last decade as gasoline and diesel fuel shortages/rationing have reduced automotive traffic.

ii. Organizational/Governance Structure

Cuba's railroad is currently operated as a fully integrated state enterprise by Cuba's Ministry of Transport. The UFC³⁵ employs approximately 23,000 staff, although moderate staff reductions have been made in recent years. Current staffing remains high for the size and volume generated by this system, but is not atypical from other government-owned and -operated systems around the world.

iii. Traffic Volumes/Commodity Flows

The UFC operates approximately 3,200 miles (5,000 km) of so-called standard gauge track. The main artery of this standard gauge line runs along the spine of Cuba, which has been nominally maintained, including for purposes of military shipments. An additional 4,400 miles (7,000 km) of predominantly narrow-gauge rail trackage is operated by approximately 80 plantation railroads that haul cargo to and from the UFC mainlines. The majority of commodities carried are related to the tobacco and sugar industries. According to various economic reports and databases, more than 70 plantations and their related rail systems have ceased operation in recent years.

Only 95 miles (151.7 km) of tracks in Cuba are electrified. This electrified section is used for commuter passenger traffic between Havana and Matanzas.

³⁵ Cuba's railroad, the *Union de Ferrocarriles de Cuba* (UFC)

a. Current State of Rolling Stock, Infrastructure, and Operations

Prior to 1959, most, if not all, of Cuba's rolling stock was U.S. made, with locomotives manufactured by either General Motors or General Electric. U.S. locomotives continue to be prized for their robustness, reliability, and relative ease of maintenance and repair. However, obtaining spare parts has been difficult, but not impossible.

Since 1959, the former Soviet Union, the former Czechoslovakia, Romania, and Canada have provided Cuba with rolling stock. These locomotives have proven unreliable after only minimal length of service, in part because of climate incompatibility. Replacement parts are scarce and directly affect UFC's ability to provide nominal service.

The freight car fleet is made up of pre-Castro era cars manufactured in the U.S., and cars more recently manufactured, mostly from former Soviet Bloc countries. To keep the fleet operational, the UFC has, since 1959, adapted and domestically manufactured spare parts from obsolete U.S. and other foreign country designs.

b. Infrastructure

As described in the October 1999 *Railway Age* magazine, UFC's "...main lines are laid with 112-pound, Soviet-supplied bolted rail, Cuban-made pre-stressed concrete ties, and screw bolt fasteners. Track products are scarce, as is maintenance-of-way equipment." In the same article, the editor states in his first hand account that "(i)n the early 1990s, UFC undertook reconstruction of its Havana-Santiago de Cuba main trunk, but this project didn't get very far due to Cuba's economic downturn. Some of the new construction has been cannibalized to repair other parts of the network."

The basic UFC main-line rail infrastructure was well designed and built and is capable of carrying considerably heavier loads, (e.g., military equipment), at greater frequency of operations if modern rolling stock were available.

Branch and/or plantation lines, predominantly of the so-called narrow gauge kind, often are in marginal shape. The condition of a small, one commodity, company-owned railroad is most often directly related to how

well that company is doing economically. In a reconstituted free market economy, a number of companies may simply want to abandon some or all of their own rail transportation in favor of other transportation alternatives.

Generally, rail hub infrastructure such as major railway stations, e.g. Havana, has been nominally maintained. Some stations have been restored and/or modernized. For instance, a major new railway station was built and brought on-line in Santiago in 1997. In 1998, rail facilities at and with access to the port of Matanzas, from where much of Cuba's sugar production is shipped, were upgraded. These cases are the exception, however, as many other stations around the country are crumbling due to financial neglect. Reflecting Cuba's dire housing shortage, it is reported that Cuban families have actually taken up residence in some stations, leading to vandalism and further, even faster, deterioration of facilities.

When Soviet aid ceased in the early 1990s, several countries signed cooperation agreements with Cuba to assist in maintaining, and in some cases, modernizing rail-related infrastructure. However, this assistance appears not to have materialized in any major way, as witnessed by recent multiple suspensions of passenger services due to track deficiencies.

Rail access to/from ports appears to be haphazard. Access to piers often is nonexistent, inadequate (one rail spur only), or in dire need of maintenance and repairs.

RECOMMENDATION:

- *Since intermodal traffic would be a major key to economic success in a free Cuba, early U.S. Government technical assistance should focus on improving rail access to/from ports.*

iv. Identified Infrastructure Development Needs and U.S. Assistance

a. Capital Improvement: Infrastructure Modernization

In 1998, the Cuba-Caribbean Development Co. estimated that approximately 30 percent of Cuba's track infrastructure needed to be replaced on a high priority basis. Capital improvements would exceed \$400 million (1998 dollars), annualized over an 8-year period. Assuming the

percentage estimate is correct, we concur with the subsequent monetary estimate to revitalize the system.

b. Capital Improvement: Rolling Stock Modernization

It was also estimated that approximately \$88 million over an 8-year period needs to be invested in rolling stock replacement on a high priority basis. However, if new locomotives are to be purchased, FRA³⁶ views this estimate as low given the cost of \$1.5-\$2.5 million (in 2004) for a modern, fuel-efficient locomotive. If 30 percent of the fleet were to be replaced, estimated by Cuba-Caribbean Development Co. to total some 236 locomotives, the cost would be roughly double that amount (\$140-\$177 million).

A more affordable scenario would be for the UFC to purchase primarily refurbished U.S. locomotives, which are available as U.S. railroads transition to more powerful, fuel efficient, and environmentally cleaner locomotives. Under this scenario, the locomotive replacement cost would total approximately \$70-\$90 million.

RECOMMENDATIONS:

- *Facilitate sale of refurbished U.S. locomotives to a free Cuba.*

c. Technical Assistance & Training

For a revitalized rail system to be economically successful and effective for potential customers/users, rail safety should become a key issue for Cuba's rail future. Rail container and general cargo movements will have significant opportunities in Cuba's future.

RECOMMENDATIONS:

- *As it has done in a number of foreign countries, FRA could assist in establishing a Cuban rail safety program. For example, several Western*

³⁶ The Federal Railroad Administration (FRA) was created by the Department of Transportation Act of 1966 (49 U.S.C. 103, Section 3(e)(1)). The purpose of FRA is to: promulgate and enforce rail safety regulations; administer railroad assistance programs; conduct research and development in support of improved railroad safety and national rail transportation policy; provide for the rehabilitation of Northeast Corridor rail passenger service; and consolidate government support of rail transportation activities.

Hemisphere countries have adopted portions of FRA's rail safety program.

- *In addition, FRA has provided on-the-job training for representatives from numerous countries, by having foreign rail safety staff perform inspections alongside FRA inspectors in FRA regions similar to the geography and climatic conditions of the visiting inspectors' country.*

4. Public Transportation

i. Introduction

Given the low level of personal auto ownership in Cuba, public transportation is a crucial element for providing the necessary mobility to drive Cuban national economic development. Ensuring that Cuba's new government is able to support the development and maintenance of an effective public transportation system is vital for economic growth.

Public transportation creates jobs and a good transit system can and does attract business. New employers will make decisions to locate or leave a community based on its transportation system. Transit provides independence and economic opportunity by connecting people to jobs. Public transportation will improve the quality of life of the Cuban people. Not only is public transportation the safest mode of travel, but it also reduces and manages congestion.

ii. Organizational/Government Structure

Presently, public transportation in Cuba is provided by state-run entities such as Cuban National Railways and the Havana Urban Bus Company. Land-use and transportation planning are important elements in developing public transportation services. These will be important areas to maintain and develop during a transition to a free Cuba.

Havana, with a population of over 2 million, will require the most intensive investments in public transportation resources. Other Cuban cities such as Santiago de Cuba, Camagüey, Holguín, and Guantanamo all have populations below 500,000 people and services can be provided to these areas through well-planned bus operations. Rural areas also have serious unmet public transportation needs.

iii. Current State of Infrastructure/Operations

a. Commuter Rail

Cuban National Railways (CNR) provides commuter rail services in the Havana area. According to *Jane's*,³⁷ CNR provides the following services: The 90 km Havana (Casablanca)-Matanzas line is electrified 1.2 kV DC. Diesel services also run from Tulipan station to San Antonio (35 km, six stations), Central station to ExpoCuba (20 km, six stations), the Los Palos line (81 km, 15 stations, peak hours only), and other routes.

b. Bus Systems

The Havana Urban Bus Company (HUBC) provides bus services. A flat fare is charged and is paid directly to the driver. According to *Jane's*, HUBC provides 100 million passenger journeys annually, with 200 routes, at a length of 2,410 km. The average peak-hour speed is 18 km/h. The fleet is composed of 3,000 vehicles, including 400 Ikarus articulated buses.

According to *Jane's*, the majority of vehicles are Girón models, built by the local Havana factory assembling kits supplied by Ikarus. Some second-hand vehicles from Spain are also in service. Huge *Tren Bus* tractor-hauled vehicles also came into service in the early 1990s, capable of carrying up to 350 people. These are commonly known as camels. *Jane's* reports that fuel shortages have put many routes out of action and that a lack of spare parts has led to a major reduction in the number of Girón buses fit for service.

c. Jitneys

Jane's reports that a large number of jitneys or *colectivo* services are operated with 1950s American sedans.

d. Ferries

According to *Jane's*, in the Havana area two ferry services operate across Havana Bay providing links within the city between the main

³⁷ *Jane's* Information Group (www.janes.com).

quayside and Casablanca and Regla. The Casablanca service provides a link into the main central business district from trains terminating at Casablanca station.

e. Subway

Havana has no operational subway, although detailed plans for a subway were developed during the 1980s.

iv. Identified Infrastructure Development Needs and U.S. Assistance

a. Capital Improvements

Cuba will require a large number of buses to meet its public transportation needs. Tied to these bus purchases are facilities for bus maintenance. Commuter rail operations may also require new rolling stock. An inventory of current rolling stock and public transportation infrastructure will need to be undertaken as part of a transitional government. As buses run on roads, the urban road infrastructure in the cities must also be at a level to permit the smooth flow of buses and cars.

RECOMMENDATION:

- *The U.S. Government could help identify U.S. companies that sell both refurbished and new transit buses. It could also identify U.S. companies with experience in developing and operating maintenance facilities.*

b. Institutional Development

The institutional ability to plan, develop, operate, and maintain public transportation services is as important as rolling stock and infrastructure. Important decisions will be made by a free Cuba, including the amount it would be willing to subsidize public transportation services, fare structures, route control, the role of the private sector in provision of services, types of services to be provided, and land-use and transportation planning.

RECOMMENDATION:

- *The U.S. Government and international financial institutions such as the World Bank can support institutional development by informing a free*

Cuba on how public transportation is structured in many developing countries.

c. Capacity Building

As public transportation is developed in a free Cuba, it will be important for Cubans to have the knowledge and capacity to maintain and improve these services.

RECOMMENDATION:

- *The U.S. Government and international financial institutions, such as the World Bank, could provide information on what types of knowledge are required within government institutions and assist in obtaining training. Also, U.S. private sector companies could provide expertise in planning, operations, and maintenance services.*

d. Privatization / Commercialization Prospects

A number of U.S. and international firms may be interested in providing public transportation services and maintenance operations in a free Cuba. A private Cuban corporation, possibly aligned with international firms, may also be able to provide services. Successful examples that a free Cuba could emulate exist in such Latin American cities as Bogotá, Colombia, and Curitiba, Brazil.

5. HIGHWAYS

i. Introduction

Successful rebuilding of the Cuban road infrastructure could be accomplished in a variety of ways. Training, capacity building, planning, and institution building, along with repair of the most significant bridges and the numerous potholes throughout the major road system, will be vital to improving Cuba's road infrastructure, as will be the goal of assisting Cubans to develop a transportation infrastructure designed for the safe and efficient movement of people and goods.

Medium-term assistance should be geared toward facilitating those projects designed to modernize the infrastructure, provide for institution

building, and establish the groundwork for long-term investment and growth. Finally, long-term planning should focus on those needs which are not immediately visible but which will arise as the island shifts into a consumer driven economy. These issues will necessitate focusing on planning, budgeting, and implementation of technological advances.

Relationships could be established with a host of partners including U.S. public and private entities, as well as international organizations such as the World Road Association (PIARC).³⁸

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government could partner with international institutions such as PIARC to support efforts in the highway infrastructure rebuilding process and to train Cuban personnel.*

ii. Organizational/Governance Structure

Currently, the Cuban Ministry of Transportation is responsible for directing, executing, and controlling the application of government policy in matters involving land, maritime, transportation or connected services, and civil maritime navigation. The list of responsibilities of the Ministry includes:

- All planning and development involving transportation.
- Environmental protection.
- Issuance of licenses on the island and within its jurisdictional waters.
- All security involving transportation matters including maritime navigation.
- Planning and maintenance of the road system.

³⁸ “The road system plays a vital role in the performance of economies, in the social functioning of communities, and in achieving effective land use and regional development. As an international open forum for information exchange, PIARC is in a unique position to address the full range of road transport and road infrastructure issues. Participants in PIARC have found that they have much to learn from each other. They could develop more effective policies and technical approaches by learning from successes and failures elsewhere. The benefit of PIARC's activity would be reflected in more efficient road administrations, an improved contribution of road transport to the wider economy, safer transport, and a more harmonious relationship among road transport, transport users, the environment, and society.” <www.piarc.org Accessed: January 2, 2004>

- Regulating all matters involving transportation including design, signalization, and maintenance of signal systems and signage.

iii. Traffic Volumes / Commodity Flows

Highway cargo transportation was 14 mmt³⁹ in 1989 and 8 mmt in 1994. Sixty-four percent of this cargo was transported under the auspices of the Ministry of Transportation; 8 percent under the Ministry of the Revolutionary Armed Forces; 7 percent under the Ministry of Sugar Industry; and 11 percent under local authorities and municipalities.⁴⁰

As Cubans come to enjoy political and economic freedom, it is reasonable to assume that the road system would be under additional pressure from increased traffic volumes and an increase in the flow of commodities across the island. The U.S. Government may be able to assist in the planning for the increased flow, and it could do so hand-in-hand with the institution building process.

iv. Current State of Highway Infrastructure

As noted previously in this report, investment in infrastructure under the Castro dictatorship has been near zero. As a result, Cuba faces a major task in rebuilding and restoring almost its entire road infrastructure. Roadways, sidewalks, highways, traffic control systems, pavement markings, signage, and guardrails are in need of repair and restoration. Perhaps 50 percent of the structures need to be replaced. As noted in a recent report, the highest priority capital improvements and expansion projects are related to Intermodal projects and enhanced access, and would total approximately \$1 billion.⁴¹

a. Primary Highways

Cuba is about the size of Pennsylvania, and it has approximately 38,000 miles of roads crisscrossing the island. Within this number are 400 miles of expressways.⁴² Of the total number of miles of roadways, only about 19,000 miles are paved. The Central Highway runs through the center

³⁹ mmt: million metric tons

⁴⁰ Cuba Caribbean Development, LLC, *"Rehabilitating and Modernizing Cuba's Infrastructure"* p. 23

⁴¹ CubaCaribbean Consulting, LLC, *Rehabilitating and Modernizing Cuba's Infrastructure*, p. 25.

⁴² <http://www.cia.gov/cia/publications/factbook/geos/cu.html#Trans> accessed, February 10, 2004.

of the island and extends between Pinar del Rio and Santiago de Cuba. Nearly all of Cuba's cities, towns, airports, harbors, and agricultural areas are accessible by paved roads. Only a few towns in the mountainous, primarily coffee producing regions in Guantanamo province, remain accessible by unpaved roads.⁴³

By the time of the 1959 Revolution, Cuba had one of the most extensive road networks in Latin America. Since then, further expansion was undertaken, although road maintenance decreased dramatically. In the 1990s, Cuba had about 12,420 miles (20,000 km) of highways, including over 9,000 miles (14,500 km) of major highways.⁴⁴ This extensive highway system transects the island, but as it was built for military purposes, it bypasses cities and towns, connecting with them through secondary roads, and is severely lacking in gasoline stations.

b. Secondary Roads

Secondary roads in Cuba make up the majority of unpaved roads on the island. These minor roads have traditionally comprised the most neglected part of the nation's road system, especially in the eastern part of the country. The absence of street lighting makes driving at night dangerous. This danger is exacerbated by the fact that some cars and most bicycles lack running lights or reflectors. Street signage, where it exists, is often confusing. Most Cuban cars are old, in poor condition, and lack turn signals and other standard safety equipment. Secondary rural roads are narrow, and some are in such bad condition as to be impassable by cars.

c. Bridges and Overpasses

Via Blanca Expressway connects Havana City, Matanzas, Varadero, and Cardenas with a total of 89 miles, 4-lane way. It has several of the most impressive bridges in the country (Bacunayagua, Canimar, and others).⁴⁵

⁴³ Cuba Caribbean Consulting, LLC, *Rail & Roads Abstract*, p. 2.

⁴⁴ Institute for Cuban & Cuban American Studies, University of Miami, <http://cuba.iccas.miami.edu/Docs/c01418.pdf> Accessed February 12, 2004.

⁴⁵ CubaCaribbean Development, LLC, "Rehabilitating and Modernizing Cuba's Infrastructure" p. 24

v. Assistance and Program Building Resources Available to a Free Cuba

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government, specifically the FHWA, could take the lead in providing immediate assistance in the coordination of emergency reconstruction and repair, as well as the provision of needs assessment and training for medium and long-term projects. Coordination with international partners will facilitate the infrastructure rebuilding and reinvigoration effort and allow the United States to focus attention and resources on the areas with the highest critical need. Similarly, coordination among various U.S. Government agencies would be useful in speeding the revitalization process and assuring the maximization of resources.*

Specific recommendations for immediate assistance to a free Cuba include the following:

a. Road Construction Assistance

RECOMMENDATION:

- *The FHWA could coordinate community based labor-intensive projects for the repair of existing roads and the development of new roads on the island.*

This approach has successfully been applied in areas where technology and resources are scarce, but where there is a large and willing labor force available. This would be particularly useful in providing immediate assistance in the City of Havana to repair roads that have suffered from maintenance neglect, and in the countryside to connect towns with new roads and pave the existing network of unpaved roads on the island.

b. Provide Training

RECOMMENDATIONS:

- *If requested by a transition government, the FHWA could take the lead in facilitating training in such areas as:*

- ***Planning and Design*** – Facilitate training in design management to Cuban transportation officials.
- ***Construction Quality Control/Quality Assurance*** – Coordinate the provision of technical manuals for road building that are in accordance with international practices.
- ***Safety*** – Coordinate training courses to inform Cuban personnel on state of the art technology road safety systems. Additionally, in the area of driver safety, “train the trainer” courses could be coordinated that would enable these persons to train other Cuban nationals. This would not only provide for immediate needs, but would also allow the U.S. Government to accomplish institution building on the island by promoting a “Road Safety Culture.” To better ascertain additional safety issues the U.S. Government may advise on, it would be important to obtain a broader assessment of the current condition of Cuba’s highway infrastructure.
- ***Project Management*** – As Cuba transforms once again into a market economy, there will be a need for training personnel in management of project financial resources and expenditures. The U.S. Government could provide assistance in the development of project timelines and management support that takes private sector initiatives into consideration. The training should be designed to focus on such things as effective utilization of project financial management systems, accounting, and financial reporting.

c. Technology Transfer

The Castro regime's self-imposed isolation from the democratic mainstream in the hemisphere means that Cuban transport authorities have not benefited from programs developed by the United States over the last 45 years. Technological, process, and systems advances, training courses, and materials have, for the most part, not reached the Cuban transportation community.

RECOMMENDATIONS:

- *If requested by a transition government, the FHWA could work side by side with Cuban personnel and international entities on the island. The promotion of T2 centers would allow for the meaningful sharing of hands-on experience and technological information.*
- *If requested by a transition government, the FHWA could also provide assistance in the area of technology transfer by providing:*
 - ***On the Job Training*** – *Working with Cuban transportation officials through a “learning by doing” approach. This would serve to update Cuban transportation entities on the latest in U.S. technology and allow U.S. personnel to assess the state of the Cuban transportation system while learning new methods of road construction that can be applied in tropical climates.*
 - ***Personnel exchanges*** – *Members of the Cuban transportation sector could be brought to the U.S., where they could participate in intense course work targeted to their specific needs. Funding would need to be provided as this is beyond the budgetary means of many individual agencies within the U.S. Government, such as FHWA.*
 - ***Support for Needs Assessment*** – *The evaluations should focus on medium and long-term needs of the Cuban transportation system by providing technical support to entities that would be engaged in the actual reinvigoration of the island’s road system. Supporting a needs assessment would allow Cuban transportation officials and those entities engaged in rebuilding to identify and prioritize specific areas of assistance. The needs assessment could consist of both organizational and functional assessments. Medium- and long-term plans of action could be used as the basis for future planning for the island. The U.S. Government could work closely with Cuban transportation officials and others in the international donor community in devising this plan*
 - *In order to accurately assess the needs of the transportation system for medium and long-range planning, it would be necessary to do more in-depth assessments than is possible without being on the*

island. Contractor evaluation teams could be hired to assist in the preparation of long- and medium-term plans for the island.

d. Coordinate with Technology Transfer (T2) Centers in a free Cuba

In Cuba, technology transfer centers have an extensive network for the acquisition and distribution of information on technology and processes throughout the island. This would cut the delivery time by working with existing entities and thus leverage resources.

vi. Preliminary Activities To Be Considered

Any development activity would require some initial preparation. In this effort, organizers could consider the following in preparation to assist Cuba, if resources were made available.

- A preliminary survey of laws to review the status of current laws in the United States and Cuba and their impact on the type of assistance that we can offer.
- Devising a hardship plan for issues that might arise as a result of staffing offices for infrastructure restoration efforts.

vii. FHWA Technical Assistance Program Participation

If the government of a free Cuba wishes, FHWA could share with Cuban authorities the benefits of its long history of providing technical assistance to countries throughout the world. The range of technology transfer material available to a free Cuba would span traditional highway transportation topics, such as transportation planning pavements, to state-of-the-art technology for intelligent transportation systems. Technical assistance could also involve institutional and program delivery issues such as enabling legislation, organizational management, value engineering, innovative financing, and private/public partnerships. Bilateral arrangements or multilateral development and technical organizations would be required. These arrangements themselves could be used as vehicles for further strengthening the ties between the United States and a free Cuba.

RECOMMENDATION:

- *If requested by a transition government, FHWA could facilitate the exchange of information between Cuba and other nations to share technological and process information that may not already be available on the island.*

viii. Coordination of International Efforts

RECOMMENDATION:

- *The U.S. Government could take part in a coordination effort with a free Cuba designed to focus the power of the existing U.S. network of research sources in identifying areas of the Cuban infrastructure that require restoration and building. The network could further act as a vehicle for transferring technological information to the island. International partners could take the lead in working with the local citizenry in speeding up the process of innovation, restoration, and reinvigoration.*

ix. Institution Building in a Free Cuba

RECOMMENDATION:

- *If requested by a transition government, FHWA efforts could be directed to institution building.⁴⁶ The FHWA could provide assistance to a free Cuba in the transition of the Cuban transportation organization into an institution that would respond to external, market-driven demands rather than military needs. Providing guidance to and facilitating training of transportation officials could assist a free Cuba with the establishment of a more efficient and effective transportation sector.*
- *The U.S. Government could assist a free Cuba by facilitating Cuban involvement and participation in training and certification programs developed in the U.S and used by our international partners abroad.*

⁴⁶ “Institution building is defined as a process of creating capacity within and among organizational sets to redefine the operating culture, formal and informal rules, convention and norms of individual and collective work in response to environmental challenges.” <http://csf.colorado.edu/sristi/papers/fpm.html> Accessed: January 7, 2004

These programs could be targeted to specific transportation infrastructure development needs and could be focused on those areas of greatest interest to Cuban transportation authorities.

- *Technical assistance could also be provided immediately by making the International Visitors Program available to Cuban transportation officials. This program is a vehicle for, inter alia, facilitation of technical exchanges. These programs bring transportation experts from around the globe to the United States for meetings with their American counterparts. As a result, relationships are established, information is exchanged, and communication between participating nations and the U.S. is enhanced. Technical information could also be provided via the Internet and CDs, as well as via hard copies.*
- *Relationships between foreign nationals and the DOT could also be available through the Loaned Staff Programs. These programs could spearhead the effort to make information available to a free Cuba by opening the door to their working with U.S. agencies. This would go a long way toward making Cuban officials aware of the latest technological advances while promoting reestablishment of ties between the two nations.*
- *Following a transition, another way to facilitate ongoing institution building efforts on the island might be to promote direct engagement with Cuban officials and transportation experts on the island. This could be accomplished through participation in Cuban organized conferences, joint workshops, and exhibitions dealing with road maintenance, multimodal transport, safety, and other similar pursuits.*

x. Privatization / Commercialization Prospects

In terms of the transportation infrastructure, privatization would mean that the rebuilding effort must be done in partnership with a burgeoning Cuban private sector. This might encourage the evolution of transportation-related private sector industries in Cuba. Prior experience has shown that privatization and encouraging private enterprises can result in increased revenues to the government, job creation, job training, and institutionalization of a private transportation industry. As with other aspects of Cuban infrastructure, the U.S. Government should facilitate the

exchange of information regarding the benefits of privatization and the experiences of other countries in this area.

6. Traffic and Vehicle Safety

i. Introduction

According to 1996 World Health Organization (WHO) / Pan-American Health Organization (PAHO) statistics, road traffic crashes are fourth leading cause of death for all ages and the leading cause of death in the Cuban population between 1-49 years of age. The 1996 data is slightly higher than previous years, suggesting that traffic crash-related fatalities are rising, based on adjusted rates. Due to the lack of better data, however, it is difficult to determine the exact scale and nature of road safety problems in Cuba, therefore any specific kind of assistance to Cuba should be preceded by a detailed analysis of Cuba's traffic safety condition.

Very little information is available on the Cuban government's approach to road traffic safety. It is unknown, for example, whether Cuba's approach encompasses all three components of road traffic safety considered by to the United States: the human/behavioral aspects, the vehicle aspects, and the environment or infrastructure. It is also uncertain whether or not motor vehicles in Cuba must meet certain standards and regulations. It is not known if Cuba develops and enforces any of its own regulations and, if so, how.⁴⁷

ii. Organizational/Governance Structure

An agency within the Cuban Ministry of Transport, the *Direccion de Seguridad e Inspeccion Automotor* (DSIA), performs some similar functions to those of the National Highway Traffic Safety Administration (NHTSA) in the United States. There are several other agencies within and outside the Ministry that also perform functions related to traffic safety. However, no information is available to determine how well coordinated the activities of these organizations are.

⁴⁷ In general, developing and vehicle non-manufacturing countries import cars that meet another country's requirements. Most vehicles around the world are built according to the U.S. Federal Motor Vehicle Safety Standards (FMVSS), which are almost identical to the Canadian Motor Vehicle Standards, or to the regulations of Economic Commission for Europe (ECE) or Japanese regulations, or, in some cases, a combination of several different regulatory systems.

iii. Identified Program Structure, Development Needs, and U.S. Assistance

RECOMMENDATION:

- *If requested by a transition government, the National Highway Traffic Safety Administration could provide training and assistance to the Cuban transition government in the establishment of all aspects of a national highway traffic safety program.*

a. Partnership with International Organizations

RECOMMENDATIONS:

- *The U.S. Government and industry could jointly:*
 - *encourage and support a free Cuba's full and active participation in vehicle and traffic safety international organizations, including the World Forum for Harmonization of Vehicle Regulations (WP.29) and Working Party on Road Traffic Safety (WP.1) under the United Nations Economic Commission for Europe, Western Hemisphere Transportation Initiative; and*
 - *facilitate Cuba's active participation in standard-setting and other professional organizations, including the International Standards Organization and the Society of Automotive Engineers.*

C. ENERGY INFRASTRUCTURE

1. Introduction

The Cuban energy sector and its infrastructure exhibit diverse characteristics ranging from a power generation infrastructure that is decreasing in capacity and reliability to an active oil and gas sector that has international private sector participation. According to the U.S. Department of Energy's Energy Information Administration (DOE/EIA), Cuba's energy consumption in 2001 was nearly 0.4 quadrillion Btu (equivalent to

approximately 200,000 barrels of oil per day).⁴⁸ Of that total, 92 percent came from petroleum, 6 percent from natural gas, and 2 percent from coal, geothermal, solar, wind, hydroelectric, and other sources. In 1999, sources report that nearly 80 percent of Cuba's energy consumption was in the industrial sector, while only slightly more than 20 percent was used to meet commercial, transportation, and residential needs.

Cuban oil production has more than doubled since 1991. In 2002, oil production averaged 49,300 barrels per day (bbl/d). The *Oil and Gas Journal* reported in December 2003 that Cuba's estimated proven oil reserves total 750 million barrels. Most domestic crude oil production consists of heavy, sulfur-laden oil, which is either used to fuel power plants or converted into useable fuels by refineries located in Cuba. Refineries also process imported crude oil. Cuba imports nearly 82,000 bbl/d of crude oil and refined products from Venezuela, representing more than a third of the island's oil demand. Cuba has a financial arrangement with Venezuela that expires in 2005 allowing for the purchase of oil under preferential conditions. Cuba also imports petroleum products from other countries, including Mexico.

Natural gas production in Cuba has also increased significantly since the early 1990s, and as of January 2003, proven natural gas reserves stood at 2.5 trillion cubic feet (tcf). The Cuban government claims increases in oil and natural gas production already fulfill more than 50 percent of domestic energy demand.

The Castro regime has set a goal to generate all of its electricity demand from domestic crude oil resources, eventually making the island self-sufficient in resources for this sector. However, limited supply and high costs of electricity have resulted in low consumption per capita and frequent blackouts in the residential sector. Unlike most countries, industrial and even commercial users have a higher priority than residential users when supplies are scarce. The Cuban regime claims that 95 percent of the population has access to electricity from the grid, leaving over 500,000 people in rural areas who must depend on other sources of power. Renewable energy (solar, wind, small hydro) plays a role in the Cuban energy sector but is still only a fraction of total energy and electricity production.

⁴⁸ Source DOE/Energy Information Administration, Total Primary Energy Consumption 2001

2. Energy Overview

Two-thirds of the energy used in the Cuba is imported in the form of oil or petroleum products. These imports are refined into petroleum products or burned in power plants in order to generate electricity. For more than three decades, Cuban imports came from the Soviet Union. After the Soviet Union collapsed in 1991, Cuba's economy contracted, in part because of the country's inability to obtain petroleum at the concessionary terms it had received from the Soviet Union. Total energy consumption has remained relatively flat after the steep decline of nearly 25 percent following the end of Soviet subsidies, but domestic oil and gas production has been increasing since 1995. Increasing Cuban oil production means fewer imports and thus an improved balance sheet. Flat energy consumption has resulted in old and inadequately maintained infrastructure for handling imports, including infrastructure for offloading and transferring the imported crude oil and products. On the other hand, new infrastructure for increased domestic production has been added.

Cuba's energy infrastructure includes the import terminals for fuels,⁴⁹ pipelines that deliver imports to refineries and power plants, pipelines (or in many cases, trucks) that deliver the products to the distribution centers, transmission lines that deliver the high voltage power to the consuming cities, transformers that lower the voltage for final distribution, and facilities for delivery to the end users. Most of the energy is consumed in the principal cities and thus the energy infrastructure is designed and maintained to meet those needs. No excess capacity is available and with any lifting of severe energy consumption restrictions or attempts to increase the gross domestic product (GDP), energy supply and delivery will be the limiting factor for economic growth given that per capita demand should and will increase significantly.⁵⁰

Total energy consumption decreased drastically after 1990 and has only recently leveled off, as can be seen in Figure 1 below. As mentioned above, most of the energy used in Cuba is in the industrial sector, while only slightly more than 20 percent is used to meet transportation, commercial, or residential needs (Figure 2 below). This contrasts greatly with other nations

⁴⁹ The "modern" port at Matanzas can handle tankers of up to 150,000 DWT.

⁵⁰ Amy Myers Jaffe and Ronald Soligo, *Energy in Cuba*, Papers and Proceedings of the Twelfth Annual Meeting of the Association for the Study of the Cuban Economy (ASCE)

where the transportation sector is a more significant consumer of energy. Less than 11 percent of energy consumed is in the transportation sector. Beginning in the early 1990s, bicycles and donkey carts often replaced buses and cars to meet daily transport needs, and by the end of the decade, up to 70 percent of the freight and more than half of intercity travel were based on the rail system.

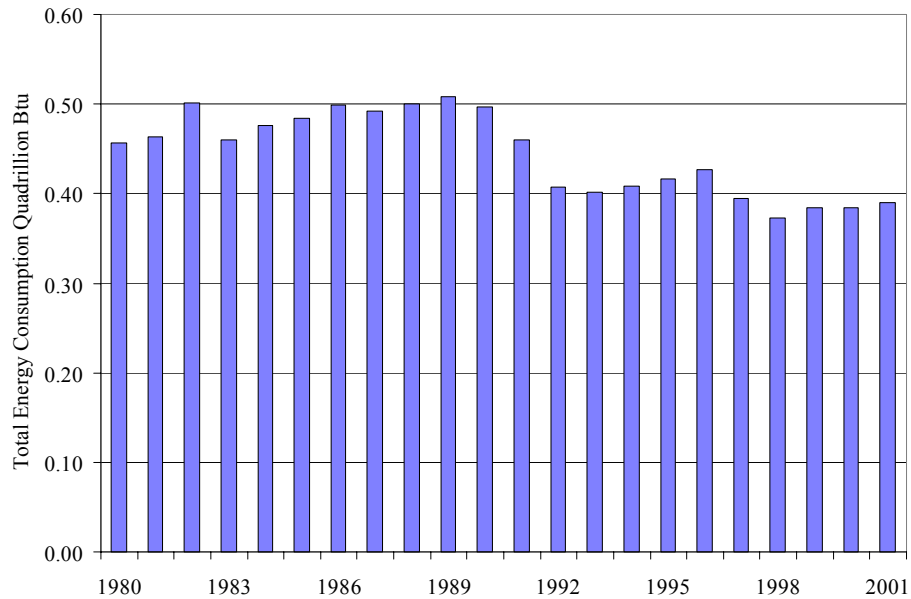


Figure 1. Historical data of total energy consumption in Cuba (Source DOE/EIA 2001)

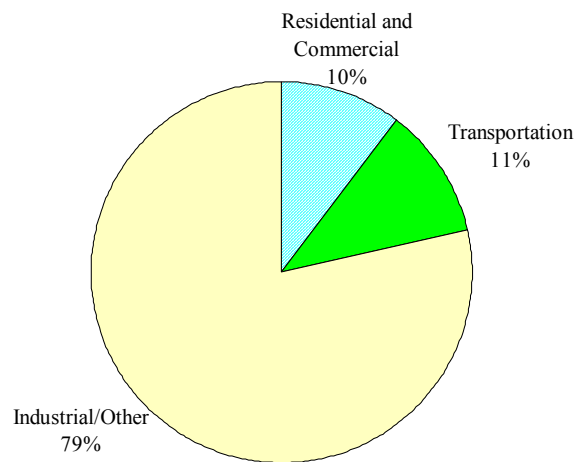


Figure 2. Estimated total energy consumption by sector (1999)

The primary energy consumed per capita in Cuba (reported in 2001 by DOE/EIA) only began increasing recently (35 Million Btu per capita; population 11.2 million) and is similar to that of the Dominican Republic (32 Million Btu per capita; population 8.53 million), which is growing at a more significant pace. However, it is well below the value before 1990, which was around 47 Million Btu per capita. Once the dictatorship in Cuba has ended and the core institutions of a free economy are being created, tourism will undoubtedly rise sharply, as will energy requirements. Thus, a reasonable long-term target may be to reach levels similar to those of Puerto Rico (108 Million Btu per capita, population 3.96 million). The speed with which this target is reached will be a function of the investments made in the energy sector in the years to come.

The latest energy balance available from the Energy Information Administration (DOE/ EIA) is from 2000; however, it serves the purpose of confirming that most of the power generated and the energy consumed in Cuba has its origins in residual fuels as seen in Figure 3.

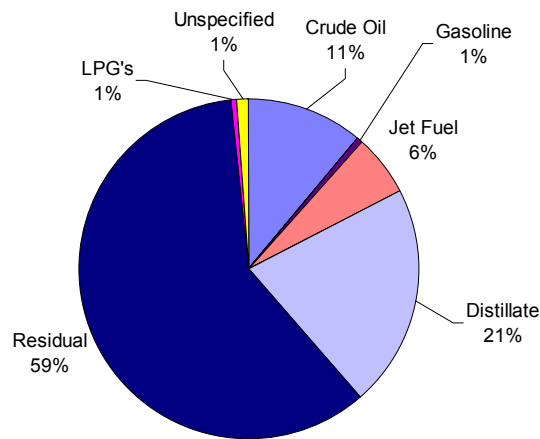


Figure 3. Fuel imports (Source DOE/EIA Energy Balance 2000)

This mix will likely evolve as domestic production of oil and gas increases and replaces imported residual fuels. DOE/EIA reported Cuban imports of nearly 130,000 barrels per day in 2000. The origin of these imports has evolved in time away from the former Soviet Union, to Mexico, and more recently Venezuela. The Caracas Accord signed in 2000 between Cuba and Venezuela provides Cuba with high volumes of crude and refined product, as well as financing terms well below market rates (2 percent

financing, in some cases with 15-year maturity). Additionally, the “accounts past due” is approaching \$1 billion payable to Venezuela,⁵¹ most of which accrued during 2003. As mentioned above, Cuba does not import natural gas products (CNG, LNG, or others). Natural gas produced in Cuba tends to be sour and in the past 5 years, efforts to process this production have resulted in approximately 200 megawatts (MW) of new power generation capacity and approximately 200 barrels per day of natural gas liquids (propane, butane, and pentane) used primarily for residential distribution.

Electricity consumption is on the rise from its 1994 minimum but still below its peak in 1990 as can be seen in Figure 4 below.

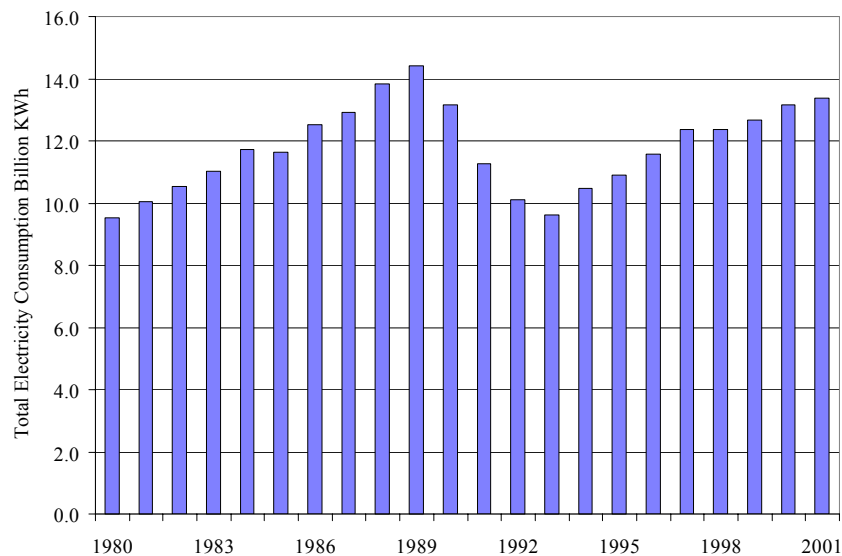


Figure 4. Total Electricity Consumption (Source DOE/EIA 2001 Assessment)

Use of renewable energy sources is receiving a great deal of attention and is playing a role in the Cuban energy mix. However, renewables are still only a fraction of total energy and total electricity production, as can be seen by comparing Figure 4 (above) and Figure 5 (below), which shows that only 7 percent of electricity is generated from renewable fuels/sources.

⁵¹ Reported in the *Wall Street Journal*, 2/2/2004 and *El Universal*, 2/07/2004.

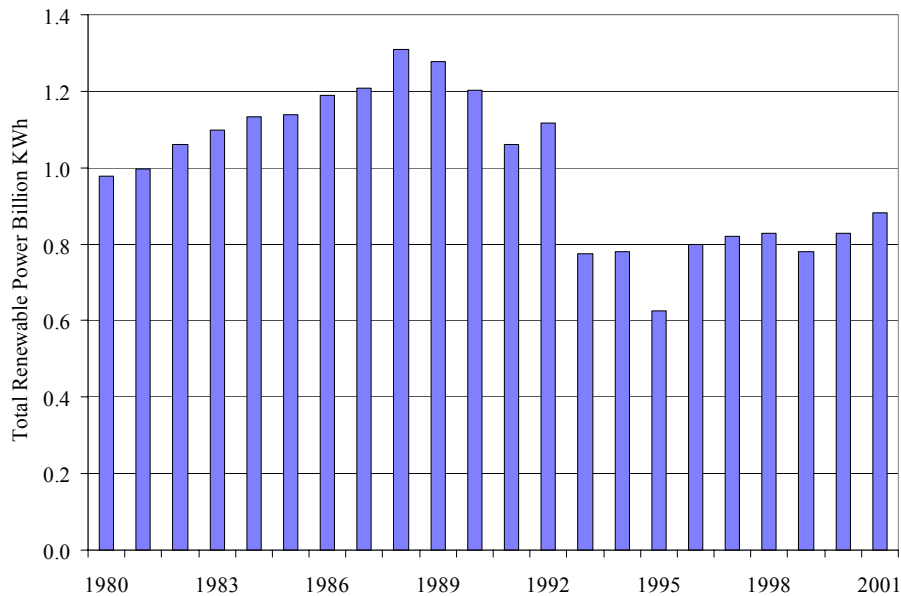


Figure 5. Power generated from renewable sources (Source DOE EIA 2001 Assessment)

3. Organizational/Governance Structure

The Ministry of Basic Industries is the Cuban government agency responsible for the activities related to the power sector (generation, transmission, distribution, and commercialization), the oil and gas sector (exploration, production, refining/processing, and commercialization of hydrocarbons and products), and the mining sector (nickel and other minerals). Additionally, the ministry is also responsible for some downstream industries such as petrochemicals. In order to better support the general activities, the ministry is also responsible for 8 “support” companies:⁵² that are in charge of performing or helping with:

- Production
- Research
- Projects
- Maintenance
- Construction
- Internal commercialization
- Importation of raw materials and components
- Exportation of finished products

⁵² See <http://www.cubagov.cu/gobierno/fichas/fminbas.htm>.

The Energy Sector Authority covers all the activities related to hydrocarbons and electricity, and currently oversees two energy producing entities: *Cubapetroleo* (CUPET) and the Electric Union. CUPET is the Cuban state oil company responsible for all matters related to hydrocarbons, while the Electric Union is a public service enterprise that generates, transmits, distributes, and commercializes electric power.

With the promulgation of the Mining Law of 1995, the National Office of Minerals Resources was created as the main regulatory agency. Its main functions are the control and supervision of the concessions in the hydrocarbon and mineral areas. That office is also responsible for the protection of hydrocarbon and mineral resources, the rational exploitation of such resources and environmental oversight of such activities.

Even though environmental oversight of exploitation activities is the responsibility of the National Office of Mineral Resources, the Ministry of Science, Technology, and the Environment is the body responsible for directing, implementing, and monitoring state and government policy related to science and technology, environmental policy, and the peaceful uses of nuclear energy. It also is responsible for biological security and monitoring chemical substances controlled by the Convention on Chemical Weapons.

4. Current State: Energy and Minerals/Mining Infrastructure

i. Oil and Natural Gas Profile

Cuba is a net importer of crude petroleum and refinery products, but in recent years has focused its efforts on increasing the production of crude petroleum and natural gas. With some foreign investment since 1997, Cuba's production of crude petroleum has doubled. Production of natural gas has increased more than tenfold.

The U.S. Geological Survey (USGS) assessed the potential for undiscovered conventional oil and gas resources in part of the North Cuba Basin during the World Energy Assessment 2000 Project. It was assessed that a potential of about 480 million barrels of oil remain to be discovered in the North Cuba Fold and Thrust Belt Assessment Unit of the North Cuba Basin. This area represents the most appealing region of Cuba from a prospecting perspective.

RECOMMENDATION:

- *U.S. Government agencies should reestablish working relationships with a free Cuba in an effort to assist with additional basin studies. Areas to focus on include: assess the North Cuba Foreland Basin Assessment Unit and the North Cuba Yucatan Shelf Assessment Unit (both of the North Cuba Basin), which was not assessed in 2000 given the lack of information. Given what the Cubans have published since 2000, these assessments are now possible. Following this, work could begin to focus on other Cuban basins and encouraging private sector participation.*

The increase in oil production has resulted in the increase and availability of natural gas for domestic use, residential, industrial, or power generation. This availability has made investments in storage and distribution of natural gas more attractive. Domestic natural gas displaces imports, and given that the transfer price to the consumer is only a subsidized production cost (as mentioned above, in some cases the transfer price is negligible), there is a decrease (if only fictitious) of energy costs to the consumer due to decreasing volumes of imports. Residential natural gas usage is still limited.⁵³

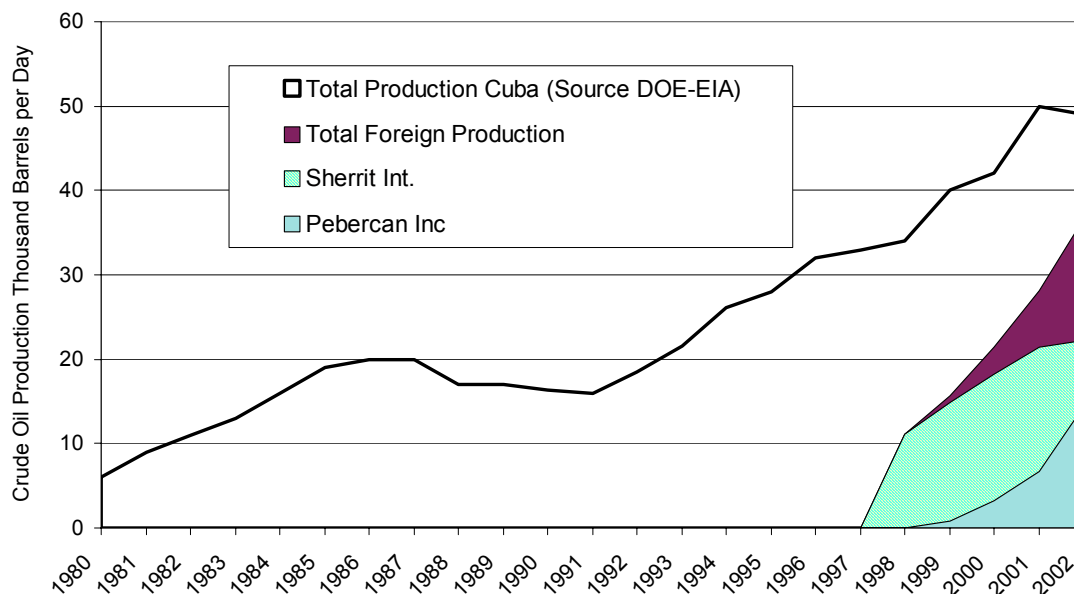


Figure 6. Historical increase in the production of Crude Oil in Cuba

⁵³ Press Release, Radio Habana Cuba, January 14, 2004

However, since 1998, numerous efforts have been made to treat the natural gas produced. *Energas*⁵⁴ receives natural gas, at no cost, from CUPET, which it processes to produce power that it sells at a fixed price of 4.5 cents per kilowatt hour (KWh) for a hefty profit. Two of the byproducts of the sour natural gas processing are sulfur and small volumes of condensates (propane and butane) and other natural gas liquids, which can be used for residential consumption.

There are examples of high quality reservoirs (Pina) both onshore and offshore. The latter will likely be tied to recent exploration activity towards the northwest of the island. For these reservoirs, lighter crude is expected. This exploration activity will likely discover hydrocarbon reservoirs that are adjacent to, or shared with, U.S. or Mexican hydrocarbon reservoirs as can be seen in Figure 7. Most territorial waters up to the international border or the end of the exclusive economic zone (EEZ) are likely to eventually be subject to exploratory efforts. If so, this could become an issue in the future, given the moratorium for oil and gas activities in Florida, and will undoubtedly be a cause for environmental oversight.

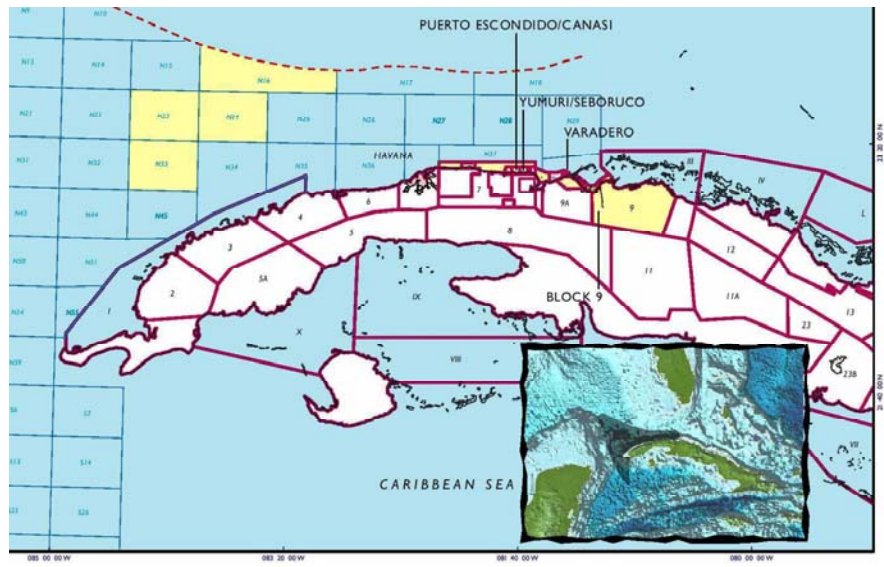


Figure 7. Offshore blocks open for Oil and Gas Exploration and Production (Source: Sherritt International Annual Report 2002 and USGS)

⁵⁴ Energas is a 20 year partnership between Sherritt International Corporation (1/3), CUPET (1/3) and Unión Eléctrica (1/3) ending in 2017.

ii. Minerals/Mining

Cuba's mining industry is dominated by the production of nickel, which is one of the country's leading sources of foreign exchange. Cuba is also an important producer of cobalt, which is a byproduct of its nickel operations. Nickel is produced by three operations in eastern Cuba. One of these operations is a joint venture between Sherritt International Corporation (50 percent) and the Government of Cuba (50 percent). The other two mines and plants are operated by the state. Production of nickel has increased significantly after Sherritt's investment in Cuba.⁵⁵ Foreign investment in the mining sector became possible when Cuba changed its law regarding foreign investment in 1992. In 1993, nickel production was only about 28,800 metric tons. In 2002, production was about 73,000 metric tons. At present, international companies are exploring at least two other deposits of nickel. The Castro regime has also worked with financial institutions like ING Bank to find ways to finance investment in its plants to improve productivity.

In addition to nickel and cobalt, Cuba is a small producer of cement, chromite, copper (although mines were being closed in 2001 and 2002), gold, gypsum, steel, silica sand, and stone and other minerals for domestic consumption. In the 1990s, several mining companies were actively exploring in Cuba. Exploration has since decreased significantly. One of the reasons was the low price of gold that prevailed in recent years.

iii. Refining

Existing production is handled in the local refineries with much difficulty given that their design corresponded to imports of Soviet crude oil, which was generally lighter and had lower sulfur content than Cuban crude oil. In the late 1980s, based on the prospects of increasing Cuban production, the Cienfuegos refinery was planned and built but did not achieve full operational status given deficiencies in its design and lack of investment. Over the years, there has been much publicized interest in the refinery so that it could be upgraded and brought online. Interest expressed by Libya, Venezuela (PDVSA), and most recently PETROBRAS and Repsol-YPF, has not resulted in a partnering agreement. One after the other, the tentative partners walked away from the refinery after completing their

⁵⁵ See Chapter 4 of this report for Expropriation issues.

evaluations. Several reports reflect that anywhere from \$100 million to \$300 million will be required to upgrade the refinery.

The three operational refineries account for approximately 110,000 barrels per day of current refining capacity,⁵⁶ which is well below their nominal capacity of over 200,000 barrels per day. Two significant refineries process most of the imported crude, one in Havana, and the other in Santiago de Cuba. Together they process nearly 55,000 barrels per day of crude. The third refinery, located in Ciego de Avila, produces 4000 barrels per day of lubricants for domestic consumption.

Infrastructure for handling crude and gas products is very limited. Most existing pipelines are not very extensive, except for the pipeline connecting the port of Matanzas and the non-operational Cienfuegos refinery. Other minor pipelines have been inaugurated in recent years,⁵⁷ such as the one that links the Nico Lopez refinery to the international airport in Havana for the delivery of aviation fuel, and another transfer pipeline, which delivers crude to the port of Matanzas. New ventures have been announced that are supposed to distribute and commercialize natural gas and natural gas liquids. The venture will have as partners CUPET, TOTAL, and Trafigura⁵⁸ and will increase direct supply of methane gas to Havana and also distribute propane gas.

iv. Electricity

The power sector has shown much less activity. Very little new investment has been made over the past decade. Major capital expenditures have concentrated on the maintenance and upgrading of old turbines and boilers that use diesel and other heavy fuels as the source of energy. The old power plants mostly run on fuels refined from imported low sulfur crude, resulting in high power costs. Some efforts have been made to upgrade the facilities and increase effective power generation capacity and/or efficiency.⁵⁹ These efforts are in some instances tied to initiatives to treat the Cuban sour natural gas and use it for power generation. As mentioned above, two integrated ventures owned by *Energas* use the associated gas production from the Varadero and Boca de Jaruco fields. This venture is

⁵⁶ Cuba News, n1, p9, Monday, January 1, 2001

⁵⁷ Oil infrastructure improves. Granma (CUBA), Friday, October 12, 2001

⁵⁸ Trafigura is a British company. <http://www.trafigura.com/trafigura/trafigura.html>.

⁵⁹ Work outsourced to foreign companies such as Spain-based Iberdrola S.A.

based on the treatment of the sour gas that was previously flared and is used in co-generation facilities to produce steam and up to 200 MW of power.

The limited supply and the high costs of electricity have resulted in low consumption per capita and have supported energy efficiency strategies, some of which can be as simple as rationing power supply. On the other hand, locally produced fuels need to be diluted (with cleaner fuels) and would still have a difficult time finding their way into the power sector without an overhaul of key components of the existing infrastructure. If environmental regulations were added to this picture, emission mitigation measures, such as flue gas desulphurization units, would be needed. If this is taken into consideration, perhaps the best possible use for Cuba's high sulfur crude is exportation in order to fund the import of more adequate fuels for local consumption. As for power transmission, the power grid is near capacity and is also declining due to the lack of maintenance. Another problem is that most of the existing infrastructure is based on above-ground transmission lines strung on wooden poles, which make the Cuban system more vulnerable to extreme weather when compared to more modern concrete poles.⁶⁰ Only parts of old Havana have buried lines⁶¹ that were recently put in place.

Most of the electric power is consumed by the industrial sector (66 percent),⁶² which has the highest priority, followed by residential use (25 percent). The commercial sector is third sector in total power consumption but tends to have a higher priority in receiving power when compared to local residential use. This prioritization and the constant energy deficit result in daily blackouts in the residential sector. Additionally, in situations of extreme deficit, industrial activity is affected. This has resulted in unplanned water shortages due to problems at the water treatment facilities and pumping stations. At times, propaganda from the Castro regime announces that with the increase of local oil and gas production, or with the oil coming from Venezuela or other news events, there would be no more major blackouts. These announcements⁶³ put a lid on news items from Cuba on blackouts that were not weather related. Blackouts are increasingly frequent.

⁶⁰ Interamerican Development Bank, EDE Sur EDE Norte Electric Distribution Project, Dominican Republic 2000.

⁶¹ Development-Cuba, Interpress Service, 9/18/2000.

⁶² Source: Energy Statistics and Balances of Non-OECD Countries 1994-1996, OECD.

⁶³ On October 30, 2000, the then Minister of Basic Industries declared an end to blackouts due to the signing of the accord with Venezuela to supply oil to the island.

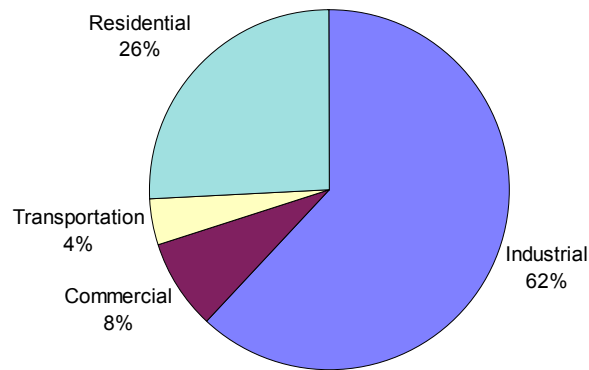


Figure 8. Breakdown of electricity consumption in Cuba (Source Union Electrica, Cuba 1999)

v. Nuclear Energy

Also in the power sector, construction on the first of many planned nuclear power plants was initiated in the 1980s with significant support from the former USSR. The *Juragua* plant was never completed and after many failed attempts to finish the project the Russian government announced in 2000 that it was officially terminating its connection with the effort, leading to the project's abandonment by the regime. There are no reported efforts to revive the possibility of nuclear generation capacity. The use of nuclear energy and science is limited to medical research and treatment, and the National Office of Mineral Resources of the Ministry of Science, Technology, and the Environment is responsible for the oversight of the handling of radioactive material.

vi. Hydropower / Dams

a. Introduction

Total power production in Cuba from hydroelectric plants is estimated to be less than 0.5 percent. Total estimated power production in Cuba in 2001 was about 15,301.3 GWh, with only about 75 GWh produced from

hydroelectric plants. The potential for hydropower is greater than what has been developed to date.

b. Organizational/Governance Structure

The Electric Union of Cuba, which falls under the Ministry of Basic Industry, is responsible for the electric grid (National Electroenergy System or NES). The Electric Union and the National Institute of Hydraulic Resources (NIHR) operate Cuba's hydroelectric stations.

c. Facilities

There are more than 220 dams and many other smaller structures for storage and diversion of surface waters.

vii. Renewable Energy

The lack of productive investment in base power generation should have provided a greater opportunity for distributed generation mostly based on renewable resources. However, this opportunity has not brought any significant results.

One renewable energy initiative that has received significant attention and publicity has been Cuba's efforts to use sugar cane byproducts as the source for biomass fuels. The waste product from sugar cane production, bagasse, is burned for fuel in other countries with sugar cane resources. While we believe this concept has not moved beyond the idea and study phase, it has recently attracted attention from Brazilian interests given their experience on the production of ethanol from biomass.

5. Identified Energy Infrastructure Development Needs and U.S. Assistance

i. Energy Sector Requirements/Opportunities

Once a free Cuba begins operating under a new, market-oriented philosophy, it will require significant increases in energy supply for transportation, to provide tourism-related services, increase production of cement and other construction materials, boost production of numerous industrial and primary goods, and to support the mining industry.

ii. Oil and Natural Gas

In the short-term, access to new capital will limit growth. In the medium-term, with the growth of the sector, other issues will come to bear such as advanced oil and gas exploration and production technology (3-D seismic, offshore rigs) and, more importantly, spill response equipment and teams. In the longer-term, as blocks closer to the international borders are exploited, the issue of shared hydrocarbon reservoirs with the United States and Mexico will likely arise. Experience from the North Sea and other areas will prove useful. Another long-term issue, enhanced and improved recovery of the hydrocarbon resources based on (treated) seawater and the use of domestic sour natural gas as a means to maintain energy (pressure) of the reservoirs, should be considered as an efficient and possibly cost effective way to improve recovery.

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government should be prepared to assist and facilitate study opportunities for transfer or application of offshore technology: production, 3-D seismic, oil spill response, or to expand natural gas processing facilities for residential and power generation use.*

iii. Minerals/Mining

In a market-based free Cuba, there is a great potential for further development of the nickel industry and for development of construction materials. The emergence of a free Cuba is very likely to increase Cuba's tourism industry dramatically, which combined with a need to upgrade existing infrastructure, will increase the domestic demand for construction materials. In addition, an overseas market for construction materials from Cuba could develop over the next ten years if the construction quarries in south Florida are used as cisterns to hold water for rehabilitation of the Everglades ecosystem. Currently, these quarries supply construction aggregate to a market that extends as far north as Jacksonville, Florida. Cuba would have to compete against other sources of aggregate such as the existing quarries on the Yucatan Peninsula and operations that might develop in the Dominican Republic.

RECOMMENDATIONS:

- *In the medium-term, the USGS should be prepared to provide assistance and facilitation to help build or modernize critical governmental institutions such as geological surveys, mines ministries, and related organizations. This would include developing and implementing mineral resource exploration programs that use modern methods and concepts, modernizing geochemical and geophysical surveys as well as geological maps, developing and implementing programs to monitor ecosystems in the face of new infrastructure development, and developing approaches to sustainable development of non-fuel mineral resources.*
- *Other U.S. Government agencies could provide assistance with modernizing mining laws, modernizing mining methods, and improving recovery of both products and waste; increasing energy efficiency of mining operations, multiple-use land management practices, remediation of abandoned mine sites, and development of new markets for materials that can be mined in Cuba.*

iv. Refining

Cuban refineries have been declining in capacity due to lack of maintenance. The immediate need is to guarantee supply of crude adequate for the programmed refinery runs and initiate a continuous effort to maintain and reclaim processing capacity. In the long-term, as the Cuban transportation sector grows to keep pace with expected economic growth, increased processing capacity could prove useful.

RECOMMENDATIONS:

- *The U.S. Government should be prepared to assist in the maintenance/overhaul of refinery units in an effort to increase/reclaim processing capacity.*
- *The U.S. Government should be prepared to assist a free Cuba increase its refinery capacity to meet increasing local demand by the transportation and other sectors.*

v. Electricity

In the short-term, access to needed capital will help pave the road to reliable electricity supply. To bridge the gap between these new investments and the dire supply situation that exists today, modular units could be brought in to increase electricity supply to major cities without relying on major transmission grids.

RECOMMENDATIONS:

- **Medium-term:** *The U.S. Government should be prepared to provide assistance in assessing the age and condition of the transmission and local distribution grids. Existing wooden poles could be upgraded to concrete poles.*
- **Long-term:** *The U.S. Government should be prepared to provide assistance in assessing existing power plants in an effort to determine if they should be converted or upgraded to process/utilize more efficient technologies through import/export incentives.*

vi. Nuclear Energy

There are no reported efforts to develop nuclear generation capacity.

RECOMMENDATION:

- *There are opportunities for interaction and exchange of information with a free Cuba on the decontamination and decommissioning of radioactive medical equipment, as well as monitoring procedures for radioactive material.*

vii. Hydropower / Dams

All indications are that Cuba's hydropower production potential has been largely untapped. In general, hydropower facilities require large initial investments but provide many years of reliable production with low maintenance.

RECOMMENDATIONS:

- *The U.S. Government could assist with planning, focused on maximizing the potential of the existing dams, and also look for hydropower development opportunities in undeveloped watersheds.*
- *The U.S. Government could assist in the development of an effective dam safety inspection program; any dams not inspected in the early (critical) phases of work should be inspected. It is very important to develop and maintain baseline data for future, periodic inspections. Inspections should be performed by an experienced multi-disciplinary team and include (if possible) individuals with historical knowledge of the dam being inspected.*
- *Based on the needs assessments developed in the inspection program, a priority list for repairs and improvements should be developed.*
- *Rehabilitation work could be accomplished using the contracts that were put into place during the critical needs phase to accomplish the work in a timely manner. All repair work should have expert quality management oversight due to the special construction requirements often required on dams.*
- *The U.S. Government, through the USACE, could provide a course in Spanish already developed for dam safety. This training could be implemented for all personnel involved in Cuba's dam safety program.*
- *The U.S. Government could assist in developing a budget and determining finance sources for an adequate dam safety program and establishing a capacity building process that includes dam operators and personnel involved in the management of the structures.*

viii. Renewable Energy

In the short-term, renewable energy resources will not supply significant energy to the Cuban economy.

RECOMMENDATION:

- *The U.S. Government can facilitate the exchange of information between a free Cuba and other Caribbean nations to share technologies and progress on the implementation of renewable energy technologies*

D. TELECOMMUNICATION

1. Introduction

The Cuban telecommunications infrastructure lags far behind the world, and is in the bottom rank of performers within the Caribbean region. Cuba, with 650,000 telephone lines in service, has a lower fixed line penetration (5.8 percent) than any large Caribbean nation with the exception of Haiti. In terms of its telecommunications development, Cuba is closer to the low-income nations of the world rather than the lower-middle income bracket to which it belongs. Consistent with the regime's efforts to portray itself as a capable partner for international investors, even as it clamps down on information dissemination on the island, Cuba's international telephone infrastructure far surpasses its domestic telephone backbone.

Telephone service varies greatly in quality from place to place despite improvements in recent years. Cubans have to wait for years to receive telephone lines, often with no success. Those who have telephones, however, enjoy fairly reliable service both within cities and long distance between cities. According to several reports, public telephones are widely available, and large numbers of public telephones have been installed that use prepaid debit cards. As telecommunications take off throughout Latin America, Cuba feels pressured to develop its telecommunications sector as well, even though the island has limited funds and few investors to finance its much-needed telecom growth. The current equipment is incapable of providing enhanced services but may be sufficient to provide basic communications services during a transition period from communism to democracy.⁶⁴ The Cuban regime claims that by 2004, 92 percent of the lines in Havana and 74 percent of the networks in the interior of the country will be digital, but there is no way to verify those numbers.⁶⁵

⁶⁴ Cereijo, M. "Telecommunications in Cuba: Recommendations for Modernization." *Cuba Transition Project, Institute For Cuban & Cuban American Studies, University of Miami*. January 2004, p.iii.

⁶⁵ Paul Budde Communications Pty Ltd. "Telecommunications and Information Highways: Cuba." 2004, p. 1.

Cuba's cellular telephone system is operated by *Cubacel* (owned 50 percent by the Cuban Ministry of Communications, 12.5 percent by *Telecomunicaciones Internacionales de Mexico* [TIMSA], 37.5 percent by Canada's multi-industrial conglomerate, Sherritt International Corp.) and C-Com (owned 50 percent by the Cuban Ministry of Communications and 50 percent by Brussels-based DHL Int'l). Cuba's mobile penetration, with 22,000 subscribers, is less than 1 percent.⁶⁶

As Cuba tries to diversify its national products and services away from commodity based sectors toward high-tech and service oriented sectors such as biotechnology, medicine, and tourism, the opportunities offered by a modern telecommunications infrastructure are becoming more evident. Regime webmasters are creating World Wide Web sites (under the ".cu" domain, but most often hosted on Canadian or other foreign servers, to overcome endemic bandwidth problems on-island) to lure in tourists and foreign investors and to sell Cuban products internationally. Domestically, historic avenues are being dug up to lay high-speed digital lines and cable.⁶⁷

i. History of Cuba's Telecommunications Sector

After four decades of neglect of the telecommunications infrastructure by the regime, the infrastructure is in poor working condition and was, by 1995, largely obsolete. Outdated coaxial cable trunk systems, using an X.25 network, are standard in Cuba.⁶⁸ High speed Internet and telecommunications services, both domestic and those connected to Cuban communities internationally, are very limited despite the 1980 Cuban Communist Party Congress authorizing the development of computerized telecommunications. It was not until 1988 that the first real domestic electronic network was operative in Cuba. AT&T, Sprint, and MCI began offering direct dialing into Cuba in 1994.⁶⁹

⁶⁶ Otero, F.J. "Mobile Opportunities in the Caribbean, 2.5 Cuba." *Baskerville Strategic Research*. (Appendix B).

⁶⁷ Barksdale L. B. "The Great Possibilities of Telecommunications in Cuba." p. 3 <http://cybercuba.com/npa1.html>.

⁶⁸ Press, L. "Cuban Telecommunication Infrastructure and Investment." *Larry Press*. August 1996. <http://som.csudh.edu/fac/1press/devnat/general/index.htm>.

⁶⁹ Barksdale, p. 3.

ii. Organizational/Governance Structure: Current Policy and Regulatory Environment

The Ministry of Information and Communications, established in January 2000, is in charge of regulating information technology, telecommunications, postal services, information exchange networks, value added services, spectrum management, and the electronic industry in Cuba.

2. Current State of the Telecommunication Infrastructure

i. Domestic Telecommunication Infrastructure

Cuban telecommunication infrastructure lags behind much of the world and the Caribbean region. The growth of the fixed-lines is much slower than in other developing nations or the world. The number of telephone lines only roughly doubled since 1995 from 350,000 to 650,000 in 2002.⁷⁰

Central office equipment currently dates back as far as the 1930s, and calls are very difficult to make. The poor infrastructure causes echo and disconnects and hinders both voice and fax calls. It is estimated that 40 percent of the Cuban telephone system was installed in the 1930s and 1940s.⁷¹ Cuban equipment comes from Alcatel and Thomson-CSF (France), Western Electric and GTE (U.S.), Nortel and Mitel (Canada), and Ericsson (Sweden), former East Germany, and Hungary. This mix of equipment of various standards and a lack of hard currency make interoperability and maintenance difficult.⁷²

ii. International Telecom Infrastructure

The majority of international voice traffic is to the United States. U.S. companies WilTel, MCI, LDDS, Sprint, and IDS began providing services to Cuba in November 1994, and AT&T upgraded its existing facilities in Cuba at that time. Canada's Teleglobe was already providing voice and data services to Cuba prior to the entry of these firms.

⁷⁰ Budde, p. 4.

⁷¹ Press, p. 2.

⁷² Press, L. "Toward a US Cuban Networking Policy." p. 2.
<http://som.csudh.edu/cis/lpress/devnat/nations/cuba/cuba4.htm>

Today the U.S. has direct dialing to Cuba and 953 authorized voice-grade (64kbps) circuits. Of these, 504 are in use.⁷³ According to Federal Communications Commission (FCC) data, in 2001, 36 million minutes were billed in the U.S. for voice traffic from Cuba. In 2002, 94 active fiber optic cable and 3,477 active satellite circuits were reported between the U.S. and Cuba. There is also a \$41 million joint venture between Cuba (51 percent) and Italcable (49 percent), which provides long distance and international service through five portable earth stations in major tourist areas. The capacity of these stations is not verified, but according to the Cuban Ministry of Communications, there are 1,109 total circuits. However, it should be noted that in December 2000, the Cuban Government cut off the receipt of direct telephone calls from the United States after U.S. telecommunications companies were prohibited by the terms of their Treasury licenses from paying a large excise tax the Cuban government had imposed on such calls. This remains the case today, although calls originating in the United States are reaching Cuba through third countries under various transiting and routing agreements that are common in the global telecommunications market.

The hard currency revenue from increased long-distance calls originating in the U.S. is providing some financing for modernization, although under the terms of the licenses, American technology may be used only for overseas calls, not for local modernization. Modernization will take time, however, since most of the equipment in use is obsolete. Cuba currently has unused capacity, which allows additional customers to subscribe to long-distance and international calling services. However, the meager incomes earned by the average Cuban citizen prohibit a significant increase in phone usage without a major price drop by phone carriers.

iii. Domestic Public Communications Service⁷⁴

a. Microwave Network

The Thompson (made in France) equipment has a capacity of 960 channels (16 supergroups of 60 channels), and it links Havana with the other provincial capitals: Pinar del Rio, Villa Clara, Camaguey, and Santiago (but not Matanzas). The terminal equipment located in Villa

⁷³ Press, p. 1.

⁷⁴ Cereijo, p. 3-4.

Clara, Camaguey, and Santiago is LTT (France). Pinar del Rio and other secondary points have VKM (Germany).

b. Coaxial Cable

The coaxial cable system in Cuba has a capacity of 1,920 channels out of Havana. The facilities terminal equipment is German-made VLV or Telemecanica VKD. The repeaters are Soviet-made, and all conform to CCITT standards. The cable runs by the new “*autopista*” superhighway all the way to Cabaiguan and then follows the old “*Carretera Central*” central highway to Santiago de Cuba. Repeaters are located every 6.3 kilometers in huts above ground.

The terminal facility has the following drops: S1 Sancti Spiritus, S2 Cienfuegos, S3 Villa Clara, S4 Villa Clara, S5 Camaguey, S6 Ciego de Avila, S7 Victoria de Las Tunas, S8 Villa Clara, S9 Camaguey, S10 Camaguey, S11 Bayamo, S12 Santiago de Cuba, S13 Guantanamo, S14 Holguin, S15 Santiago de Cuba, and S16 Cerro Pelado, plus 24 channels to Jamaica. The drop in Cerro Pelado links to a microwave system and is used for aerial corridor communications (AICC). The equipment located at the provincial capitals is terminal equipment. At other points, it links with the CW20.

iv. International Long Distance Service⁷⁵

a. Satellite

Cuba has access to satellite transmission via its station “*Caribe de Comunicaciones*” which is associated with the Russian manual Intersputnik system with 60 channels. In 1979, Cuba installed a new Standard B Intelsat earth station, which is an automatic Japanese station with 24 channels.

b. Coaxial Cable

A submarine cable was installed in 1950 between Key West and Havana using an analog carrier system. It is composed of two coaxial cables, one for each direction of transmission, and it was originally designed to carry 24 voice channels. The terminal equipment for this

⁷⁵ Cereijo, p. 5-6.

system is located on the third floor of the former Cuban Telephone Company on Aguila and Dragones streets. This equipment was damaged by fire several years ago. A new cable was placed by ITT from Key West to Caviar. From Caviar, it terminates in the International Communications Complex in Havana with a capacity for 138 channels. The terminal equipment has not been installed due to the U.S. trade embargo with Cuba.

c. Microwave

An over-the-horizon troposcattering system was placed in service in September 1957 for the transmission of one B&W video channel and 36 audio channels of 4 MHz. When functional, this system was composed of three radio spans. The first operated at 3 GHz from Havana to Guanabo; the second operated in the UHF range between Guanabo and Florida City; and the third operated at 3 GHz between Florida City and Miami, with a repeater located in Goulds. In Havana, the system terminated on the first floor of the Edificio Masonico, located at Carlos III No. 508. The TD-2 transmitters/receivers resided at the above location along with the L-1 carrier equipment, both made by Western Electric. In Guanabo, in addition to the microwave transmitters, two government systems operated at 10 kilowatts at frequencies of 692 MHz and 740 MHz, along with two receivers tuned to 840 MHz and 880 MHz. Both were connected by waveguide to 60-foot parabolic antennae.

v. Broadcast

a. Radio

There are approximately 30 state-run public radio stations throughout the island. Private broadcasting is forbidden by law. In addition, there are a number of military radio stations with state-of-the-art equipment and broadcast towers. There are three main government-owned, public radio stations: *Radio Rebelde*, *Radio Reloj Nacional*, and *Radio Progreso*. There are a total of 62 radio transmission towers.⁷⁶

⁷⁶ Exhibit T: Cuba's Telecommunications Summary of Major Study Results. *CubaCaribbean Consulting, LLC*, p. 47.

b. Television⁷⁷

Television signals, from regime-controlled stations, are available to approximately 70 percent of the Cuban population. Private television broadcasting is forbidden by law. Most of the large population centers receive more than one service. However, two large population centers, Santiago de Cuba and Camaguey, have single service. Televisions are available in a relatively large number of households at 15 sets per 100.

There are a total of 35 television transmitters and 45 relay stations. The total KW power in the countrywide network is 197.6 KW. In support of the system, there are a series of microwave relay stations that allow for live transmission from practically anywhere in the country.

As described above, Cuba has access to satellite transmission as well. Some Cubans have accessed U.S. satellite feeds with homemade satellite dishes.

In January 1996, Cubavision International introduced a new cable channel for hotels in Havana's tourist installations, diplomatic areas, foreign companies, and for foreigners residing in Hotel La Habana. Payment for this new service is required in U.S. dollars.

Given the dissimilar radio allocation plans of the United States and Cuba and their close proximity, there is a history of interference issues between the two countries. In a free Cuba, we will need bilateral spectrum agreements to ensure an orderly and compatible use of the spectrum in the proximity of U.S. national territory to protect radio industries in both countries.

vi. Mobile Communications

Unlike most of the world, mobile services in Cuba are still considered a luxury item and network coverage is limited and mainly focused on tourists. Service is unavailable to large portions of the island's population but readily available to its roaming tourists. Even though Cuba had a 75 percent growth in its mobile subscribers since 2001, mobile penetration only reached 0.19 percent in 2002. There are

⁷⁷ Ibid, p. 47-48.

two mobile operators in Cuba: Telefonos Celulares de Cuba (Cubacel) and Celulares del Caribe (C-Com).

In a free Cuba, the mobile services can be expected to significantly expand, which will give rise to the need for bilateral radio spectrum agreements to ensure an orderly and compatible use of the spectrum in the proximity of U.S. national territory. Such agreements would be similar to those now in force with Mexico and Canada.

vii. Internet Services

Despite the growing awareness of the Internet among the Cuban populace, public Internet access is still very limited due to restrictive policies of the regime, concerned about unlimited access by average citizens to unfiltered news; costs; strict and severe penalties for using the Internet; and inadequate infrastructure. Users must prove that they are engaged in research or belong to accredited, state institutions. Internet access is limited to tourists and users authorized by the government. High-speed services such as DSL are non-existent in Cuba.⁷⁸

For a private citizen to have full internet access in Cuba, the individual must have (1) a private telephone line (which is difficult to obtain); (2) an Internet access device, usually a personal computer with a modem; and (3) dial-in capability to the Internet for a monthly fee (about \$35 per month; average monthly wage in Cuba is \$13). Full Internet access through the black market is one of the most rapidly growing areas of the underground Cuban economy. To offset this rapid growth of black-market accounts, or “account sharing,” that provide access to uncensored information, the Castro regime is operating “Cyber Cafés” where individuals seeking Internet access can pay \$3 per half hour to surf the web or send e-mail messages.

a. Internet Infrastructure and Services

The Center for Automated Information Interchange of the Cuban Academy of Sciences (CENIAI) has had a UUCP (Unix to Unix copy protocol) link to the Internet since 1992, originally through a single unreliable twice a day dial-up link with the Association of Progressive

⁷⁸ Budde, p. 4.

Communication's (APC) Toronto Office, Web Networks. By 1996, there were four networks with international dial-up connectivity in Cuba described below.⁷⁹ Although in 2003, there were ten companies offering Internet services, most of Cuba's Internet traffic runs through two main servers: CENIA Internet and Infocom operated by the incumbent para-statal telecom service provider, ETECSA.⁸⁰

Citmatel, a branch of the Ministry of Science, Technology, and the Environment, operates CENIAI. As of 1996, it offered e-mail, database access, mail lists, programming and consulting services, and a presence on a Gopher server in Uruguay. Other Cuban networks include Tinored, which was established by the Cuban Youth Computer Clubs, an initiative of Fidel Castro that operates 150 walk-in computer centers in Cuba. In 1996, about 100 clubs had e-mail accounts and about 80 had working 2,400 bps modems. Tinored is also a gateway for Red David, which supports Cuba's government-operated non-governmental organizations. CIGBnet is the network of the center for Genetic Engineering and Biotechnology. It started operations in 1991 and had 900 users in 1996. It provides e-mail, database access, a biological sequence server, mailing lists, and Gopher and Web servers. Finally, InfoMed is the network of the National System of Health Information of the Cuban Ministry of Health, which has been operating since 1992. It had some 500 accounts in 1996 most of which were shared. It provides e-mail, discussion groups, file retrieval, database search, and consultation services.⁸¹

In addition to government imposed access restrictions, Cuba's antiquated telecommunications infrastructure further hinders Internet access. In many areas of Cuba, modems work reasonably well at a speed of 1,200 baud (fast enough for e-mail and limited text transmission), but they cannot achieve the 14,400 to 28,800 baud modem speeds required for efficient access to the Internet. The current infrastructure is saturated. To relieve demand on Cuba's limited international telecommunications links, many Cuban web sites in the ".cu" domain are hosted on web servers physically located in Canada.

⁷⁹ Ibid

⁸⁰ Budde, p. 5.

⁸¹ Press, L. "Internet in Cuba." Larry Press. 1997.

b. Computers

In a measure intended to facilitate censorship of information, it is forbidden by law for Cubans to buy computers, printers, or faxes.

c. E-mail

In Cuba, use of e-mail is much more common than use of the Internet. According to a report of the MIC, dated January 2004, Cubans hold more than 480,000 e-mail accounts (compared to 60,000 in 2001). Many of those with access to domestic or international e-mail through government jobs and schools can also access a government-controlled intranet, consisting of several hundred officially approved web pages hosted on servers in Cuba with no direct connection to sites on the world wide web.⁸²

Cuban post offices began to offer, in the summer of 2001, e-mail and intranet access priced in U.S. dollars.⁸³ In 2002, Cubans could purchase an e-mail account for \$4.50 (the average wage in Cuba is around \$13/month).⁸⁴

d. The Government's Use of the Internet

The past several years have witnessed a considerable increase in the number of official web sites that have appeared on the Internet. The increase reflects the Cuban government's priority to use this medium to project a benign, positive image and to promote the use of electronic commerce in industries such as tourism that can generate hard currency. According to MIC, Cuba had approximately 1,100 ".cu" domains in 2003. The Internet has been facilitated by financial investments in telecommunications infrastructure to update the antiquated telephone network to a digital one.

e. New Restrictions Amidst Ongoing Upgrades

In a move to clamp down on unauthorized use of the Internet, in January 2004, the MIC introduced a law that would have prohibited Internet access over the low-cost government service most ordinary citizens have at home. The law, which has been denounced by Amnesty International and

⁸² Ibid, p.7.

⁸³ Ibid, p.7.

⁸⁴ Budde, p.5.

others, limits access to those organizations (officially recognized businesses and government offices) that access the web through telephone accounts paid for in U.S. dollars.

The new law represented a fearful regime's effort to clamp down on a growing group of users, semi-tolerated until now, who access the Internet illegally from their home telephones, using passwords from their workplace or using computers and Internet accounts they have borrowed or purchased in Cuba's active underground cyber-market. This move can be viewed as part of a broad trend against activities deemed "illegal" by Cuban authorities, such as unauthorized private businesses and the sale of houses. After the story leaked to the foreign press, and protests were organized internationally, the regime retracted its planned crackdown.

The law, in fact, would have changed nothing for most ordinary Cubans who do not have authorized access to the worldwide web. This access is limited to select government institutions, scientists, academics, the diplomatic sector, approved businesses, and state approved organizations. The regime closed all unauthorized free email accounts by blocking access to overseas servers in 2003. Full Internet access is available at the main hotels, which offer this service in dollars. Service at government-owned Internet cafes is limited to the Cuban "intranet" of approved sites.

3. Identified Infrastructure Development Needs and U.S. Assistance: Pro-Competitive Telecommunications Policy and Regulatory Framework

To achieve a sustainable market-based telecommunications sector, Cuba will need extensive policy and regulatory training and technical assistance to develop a telecommunications policy and a legal and regulatory structure that would attract private investment and promote competition to expand and modernize the telecommunications infrastructure at affordable prices.

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Government should be prepared to assist a free Cuba with regulatory training and technical assistance. The U.S. Government, through the Department of State (EB/CIP), Federal Communications Commission (FCC), and the*

National Telecommunications and Information Administration (NTIA) could assist Cuba by:

- *providing telecommunications-related legal expertise in drafting legislation;*
- *providing assistance in improving the spectrum management framework; and*
- *negotiating bilateral radio spectrum agreements with the United States and new international broadcast frequency arrangements.*

The World Bank and other international donor agencies, and the private sector, in cooperation with countries in the region, can begin assisting the Cuban telecommunications sector as soon as conditions allow the placing of advisors in the Ministry and inviting Cubans for training outside the country.

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Government should be prepared to assist a free Cuba by:*
 - *providing experts to draft laws and regulations and advise on policy and regulation by assembling an ad hoc team of U.S. regulatory experts to respond to Cuban needs;*
 - *participation in general training programs provided by the U.S. Telecommunications Training Institute (USTTI). The USTTI is a non-profit joint venture between leading U.S. based communications and IT corporations and leaders of the federal government and could provide Cuban telecom experts tuition-free management, policy, and technical training;*
 - *participation in the International Visitors Program (IVP) of the FCC, which enables foreign delegations to interact in informal discussions with FCC personnel who provide legal, technical, and economic perspectives on a wide range of communications issues involving broadcasting, cablecasting, and telecommunications. During IVP briefings Cuban telecom experts could learn about the FCC's*

organizational structure, its multiple roles as an independent regulatory agency, including licensing, enforcement, and rule making procedures, and its statutory powers, regulations, and current proceedings; and

- *participation in the Standards in Trade Workshops, which are a major activity of the Global Standards and Information Group (GSIG) of the National Institute of Standards and Technology (NIST). The workshops could provide Cuban standards officials with timely information on U.S. practices in standards and conformity assessment. Participants would be introduced to U.S. technology and principles in metrology, standards development and application, and conformity assessment systems.*

E. WATER RESOURCES

1. Introduction

i. Organizational/Governance Structure

The water sector has an institutional structure that provides for the functioning of the sector as well as its development. It is a complex system that has evolved since 1976.

There are two main governmental organizations that develop and regulate the water sector: the National Institute of Water Resources and the Ministry of Public Health. The National Institute of Water Resources controls all the activities to develop and operate the systems. The Ministry of Public Health sets the regulatory requirements for potable water as well as the quality and treatment of wastewater.

ii. Wastewater Systems

Cuba has significant water supply and sanitation issues. There are only five municipal wastewater plants in the country and only 4 percent of the sewerage effluent have some degree of treatment serving 18.9 percent of the population. Most old cities, such as Havana, have aging, combined sewers (combined storm and sanitary sewer). Havana's sewers were designed for a population of 600,000 - when the present population is over 2

million. The wastewater flow only receives primary treatment, and excess flow is discharge to bodies of water with minimal, if any treatment.

iii. Urban storm drainage

Similar to the United States, urban storm drainage in Cuba is primarily governed and performed at the provincial and municipal level. It's reasonable to assume a very wide range of urban drainage practices, regulations, and effectiveness of the various systems in place. It will require a significant effort, in country, to assess the state of affairs in urban drainage.

iv. Water Supply

Potable water supplies/quantity are summarized in the table below.

Water Supply and Sewerage Coverage ¹			
	Urban	Rural	Total
Population	8,376,000	2,761,700	11,137,700
Water Supply			
% Served	98.3	76.5	92.9
% Home Connect	83.5	38.5	72.4
% Easy Access	14.8	37.9	20.5
% Disinfected	83.5	Negligible	
Sewerage			
% with Sewers	48.5	7.7	38.4
% with Latrines & Pits	49.5	76.2	55.4
% Treated	18.9	-	-

¹ Source: CEPIS, "Assessment of Drinking Water and Sanitation 2000 in the Americas, PAHO, Sep 2001.

v. Storage

Due to the narrow east-west extension of the island, rivers are short and mostly flow to the north or to the south with relatively small water volumes. The annual average rainfall is 1,200 mm. (48 in.) with 30 percent

in winter season and 70 percent during the summer season. The heaviest rain falls in Sierra del Toa. The principal watersheds are: Cauto Watershed with 9540 sq. km.; Zaza Watershed with 2413 sq.km.; Guantánamo-Guaso Watershed with 2347 sq. km. and Toa Watershed with 1061 sq. km. The river lengths vary as follows: Cauto River with 370 km.; Sagua La Grande River with 163 km.; Zaza River with 155 km.; Caonao River with 133 km.; San Pedro River with 124 km.; Jatibonito del Sur River with 119 km.; Las Yeguas River with 117 km.; Cuyaguante River with 112 km.; Mayari River with 106 km.; Hondo River with 105 km.; Agabama River with 105 km.; and Toa River with 100 km.

Most of the rivers have been dammed to catch the runoff water for irrigation and water supply. Cuba has more than 220 dams and minor storage structures for water, with a combined storage capacity of 626,445 hm. Much of this developed water is for agricultural production. The plan for water resources development in the second half of the 20th Century was to store as much water as possible, even at the risk of drying up the streams. However, the damming of nearly all the major rivers has reduced the flow in the river channels and exacerbated the salt-water intrusion along the coastal areas.

vi. Treatment

Drinking water services in Cuba are classified in three classes: (1) domestic connections, where the residence is connected to the water supply system; (2) public service, where water truck tanks distribute the water; and (3) easy access service, where the water must be carried for a distance of 300 meters. Presently, 95.5 percent of the population has access to these services in the rural and urban areas. The total population of Cuba has been estimated at 11,224,321 (July 2002 estimate) with an average annual rate of growth of approximately 0.35 percent.

Of the supplied water for domestic use, 90 percent of the urban potable water is from ground water sources, with approximately 83.5 percent of the urban water supply systems using disinfection practices as its only treatment. 78 percent of these systems have intermittent service, and water availability is only for 12.2 hours/day.⁸⁵

⁸⁵ According to the *Regional Report on the Evaluation 2000 in the Region of the Americas* prepared by the Pan American Health Organization (PAHO) and the Division of Health and Environment of the World Health Organization (WHO) dated September 2001

There are 52 treatment plants that provide full treatment through flocculation, sedimentation, filtration, and final disinfection. Problems in maintaining treatment are primarily due to needs for equipment spare parts and replacements, chemicals and fuel and electrical power limitations.

vii. Distribution

The major cities have distribution systems, some of which date back to the mid 1800s. Such is the case of the Havana system, known as the Albear Aqueduct. The coverage of the water supply service and the frequency of delivery are still considered inefficient to supply the Cuban population.

The following table illustrates the type and coverage of the water supply systems: The urban unserved population is 145,200 (1.73 percent) and the rural unserved population is 650,400 (23.55 percent). The total unserved population is 1,017,900 (12.39 percent). About 98 percent of the rural water supply systems are in operation. The distribution system loses nearly 75 percent of the treated water due to leaking pipes.

TABLE OF DRINKING WATER COVERAGE IN CUBA					
Service Area	Total Population	Population Served	Domestic Connection	Public Service	Easy Access
Urban Area	8,384,300 (100 %)	8,293,700 (98.9 %)	7,059,580 (84.2 %)	394,062 (4.7 %)	838,430 (10 %)
Rural Area	2,755,500 (100 %)	2,349,200 (85.2 %)	1,248,242 (45.3 %)	294,839 (10.7 %)	806,119 (29.2 %)
Total Area	11,139,800 (100 %)	10,642,900 (95.5 %)	8,120,914 (72.9 %)	690,668 (6.2 %)	2,328,218 (16.4 %)

Source: National Institute of Water Resources, 1999

The water supply coverage and types by Provinces is shown in the following table:

TABLE SHOWING THE TYPE AND COVERAGE OF WATER SUPPLY SERVICE BY PROVINCES N CUBA
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Province	Total Population	Population Served	Domestic Connection	Public Service	Easy Access
	000's	000's	%	%	%
Pinar del Rio	731.29	689.2 (94.2 %)	71.5	5.9	16.8
La Havana	696.19	659.9 (94.8 %)	92.2	2.0	0.6
Havana City	2,192.32	2,192.3 (100 %)	99.3	0.7	0.0
Matanzas	654.52	654. (100 %)	87.0	2.3	10.7
Villa Clara	833.42	769.5 (92 %)	68.6	2.3	21.1
Cienfuegos	392.35	392.3 (100 %)	71.7	9.9	18.4
Sancti Spiritus	458.78	422.0 (92 %)	54.7	6.6	30.7
Ciego de Avila	403.88	384.4 (95.2 %)	73.8	13.7	7.7
Camaguey	782.23	773.9 98.9 %)	65.5	3.3	30.1
Las Tunas	525.02	482.3 (91.8 %)	59.3	5.0	27.5
Holguin	1,024.91	1,001.3 (97.7 %)	46.1	13.7	37.9
Granma	827.59	743.8 (89.9 %)	62.7	8.2	19.0
Santiago de Cuba	1,027.91	925.9 (90.1 %)	74.2	12.1	3.8
Guantánamo	510.76	472.5 (92.5 %)	68.3	11.2	13.0
I. de la Juventud	78.69	78.6 (100 %)	100	0.0	0.0
TOTAL	11,139.87	10,642.9	72.9	6.2	16.4

Source: National Institute of Water Resources, 1999

viii. Ambient Water Quality

Surface and groundwater in Cuba are severely polluted by runoff from heavily treated fields with fertilizers, pesticides, and herbicides, as well as by the discharge of untreated effluents from cities and industries such as sugar mills, sugar by-products, food processing plants, mining operations, etc.⁸⁶ The Castro regime's fixation with irrigation resulted in very high rates of extraction of groundwater, causing groundwater levels to drop, salt-water intrusion, and increased salinity of the soils near the coasts. In addition, an extensive dam construction program reduced the river flows and limited the natural recharge of aquifers, increasing the salt-water encroachment, especially in Ciego de Avila Province. The insufficient levels of wastewater treatment and the lack of sewer pipelines have caused a degradation of the water quality.

2. Identified Infrastructure Development Needs and U.S. Assistance

The U.S. Government has limited technical expertise for addressing primary infrastructure issues, as states and local agencies, with the help of private sector engineering consulting firms, have primary responsibility for these issues in the United States. The U.S. Government does have experience in bringing together small ad hoc teams of experts from around the country to act as consultants to other countries on a limited basis. This type of team is most likely not appropriate for a full scale assessment and potential rebuilding of a nation's infrastructure.

RECOMMENDATIONS:

- *U.S. Government should be prepared to provide capacity building expertise. Capacity building includes, but is not limited to, development of monitoring programs, review and assessment of water quality data (drinking water, effluent discharge, ambient water quality), long-term development of laws and regulations, and development of pre-treatment programs (control of industrial discharges into public waste water systems), etc.*

⁸⁶ Díaz-Briquets, Sergio and Jorge Pérez-López, *Conquering Nature: The Environmental Legacy of Socialism in Cuba*. Pittsburgh: University of Pittsburgh Press, 2000; and, López Vigil, María, "Cuba Campaign: Twenty Issues for a Green Agenda," *Global Exchange*, 5 October 2001 <http://www.globalexchange.org/campaigns/cuba/sustainable/lopez100501.html> (23 January 2003)

- *The U.S. Government could help a free Cuba develop a water and wastewater plan similar to the one being done along the California/Tijuana, Mexico border. The Plan would assess current potable water resources and needs, future potable water needs, current wastewater infrastructure resources and needs, and future wastewater needs.*
- *The U.S. Government could also provide assistance on lab improvement and treatment optimization. A significant consideration whether there exists an administrative structure and potential for binding requirements on the water suppliers in Cuba to value and maintain improvements over time in these areas. If the appropriate institutional infrastructure and political support are not present, long-term sustainability is unlikely. Hence, it is important to collaborate with and empower local officials to carry out meaningful improvements.*

Long-term infrastructure financing is critical for lasting water and wastewater capital improvements. The U.S. Government has vast experience and is investigating innovative financing schemes that could promote financing for long-term capital improvements.

RECOMMENDATIONS:

- *If requested by a transition government, the U.S. Government should be prepared to assist a free Cuba to:*
 - *develop sectorial water demand projections by providing tools to engineers and planners such as IWR-Main;*
 - *perform supply-demand analysis of the major water supply systems;*
 - *evaluate minimum in-stream flows required for ecosystem maintenance; and*
 - *conduct watershed analysis and sanitary surveys for surface water systems.*

3. Flood Plain Management and Flood Control Infrastructure

i. Organizational Governance/Structure

The development of flood control infrastructure has been very limited during the second half of the 20th Century. The civil defense, which encompasses a set of measures and activities, is under the Armed Forces Ministry. This structure develops general and specific plans for the response to disasters. From the tabulated information below, 32 percent of Cuba's population is living exposed to flooding.

Disaster Risk for Floods, 1980-2000¹	
Events per Year	0.71
Killed per Year	5.00
Killed per Million	0.47
Average People Exposed per Year	3,482,880
Physical Exposure percent of Population	32.53
Relative Vulnerability, Killed per exposed 10 ⁶	1.44
Density Population living exposed to flood in h/km ²	116.93

¹ Source: UNDP, "Reducing Disaster Risk: A Challenge for Development", 2003

ii. Current flood control infrastructure

Specific information on Cuba's existing flood control infrastructure is not known. The vast majority of Cuba's large-scale water resources projects have been to capture rainfall runoff; available data on their dams shows that most do not have a significant flood control component. The data in the above table indicates that flooding in Cuba does not present a huge problem in terms of loss-of-life potential. Property damage statistics for flooding are not known. Before any specific flood control recommendations can be made or before any priorities can be established, a far greater understanding of the current situation is required (institutional, infrastructure, and history of flooding).

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government should be prepared to offer state-of-the-art hydrology and hydraulic computer*

models that delineate flood prone areas with far greater accuracy than previously possible. These tools can be employed to allow informed decisions to be made regarding infrastructure investments and zoning restrictions. USACE can provide the engineering tools and training; courses in Spanish are already available and have been presented in other Latin American countries.

F. CULTURAL AND HISTORICAL INFRASTRUCTURE

1. Introduction

Cuba has one of the greatest collections of architecture in the Caribbean and Latin America. Four hundred years of Spanish rule and growth during Cuba's Republican period created a unique architectural legacy. Cuba's focus on rural development and the utter lack of investment in the cities had the unintended but, from an architectural history perspective, fortuitous result of sparing Cuba some urban renewal schemes that have fundamentally changed the character of many cities throughout Latin America and resulted in the razing of historically relevant buildings.

In early 1990s, as it scrambled to attract tourists to the island, the regime realized that its architectural legacy could also serve as an engine for tourism and economic development, although these government-led efforts are limited.

2. Identified Infrastructure Development Needs and U.S. Assistance

The successful rehabilitation and reuse of the hundreds of available historic buildings will require the participation of the private sector. Many of these buildings can be rehabilitated into homes, offices, and stores. These buildings require sensitive design solutions that respect the integrity of the original design yet incorporate modern amenities and uses.

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government should be prepared, through the Department of Housing and Urban Development (HUD), to coordinate technical assistance with international organizations such as International Council on Monuments and Sites*

(ICOMOS) and national organizations such as the National Trust for Historic Preservation.

Organizations such as the *Instituto Cultural Puertorriqueña* could also be of assistance with its long and accomplished history in Old San Juan and other historic cities of Puerto Rico. Since they share a similar architectural legacy, their assistance could be greatly beneficial.

V. ENGAGING AND EMPOWERING THE CUBAN PEOPLE

As mentioned throughout this chapter, Cuban infrastructure development and modernization efforts, as assisted by the U.S. Government, would actively involve the Cuban people. These efforts will not only provide a practical means to rebuild a free Cuba's infrastructure but could also provide stability during a transitional period.

Decisions regarding the nature and scope of many programs and projects will require local community involvement and support. Infrastructure improvement activities will provide opportunities for businesses and workers to establish themselves and grow under a new political and economic system. The resulting development and modernization will enable commerce and an entrepreneurial spirit to flourish at all levels, especially for those enterprises that are directly related to the infrastructure. For example, in many parts of this chapter, the prospects for various types of privatization are discussed. There are few better ways of empowering and engaging individuals and groups than investing them with the rights and responsibilities of ownership in infrastructure and related activities, which are literally the foundation of any modern society and economy.

Below are a few of the many ways in which U.S. Government assistance in the area of infrastructure modernization can engage and empower the Cuban people.

A. Community Based Labor Intensive Road Construction

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government should be prepared to assist a free Cuba by promoting and facilitating community-*

based labor-intensive road construction efforts. A road construction expert from the United States could be teamed with community organizers and local officials in Cuba to organize and carry out road construction projects.

This type of program could accomplish immediate infrastructure development by paving miles of roads with a relatively small capital investment. Projects of this kind provide growth while simultaneously creating jobs and providing training.

B. Construction Industry

By its very nature, physical infrastructure modernization will be dependent upon the Cuban construction industry. Presently, the construction industry is made up of various enterprises and companies, all state-controlled, under the Ministry of Construction (MICONS), with no opportunity for private-sector initiative. There are mixed companies, those foreign Construction and Development enterprises doing work in Cuba associated with the regional companies under MICONS. Because Cuban companies and enterprises have limited capabilities with respect to equipment and the use of the latest construction materials and techniques, one urgent task is to develop those enterprises quickly to bring them to up to par with the higher standards of the global construction industry.

RECOMMENDATION:

- *If requested by a transition government, the U.S. Government should be prepared to offer training and an introduction to state-of-the art equipment and technical software products.*

C. Architect/Engineer (A/E) Community

A similar effort is needed for the Architect/Engineer (A/E) community. They are currently grouped primarily under the *Union Nacional de Arquitectos e Ingenieros de la Construcción de Cuba* (UNAICC). To support the initial contracting efforts with A/E and construction companies, and in turn the involvement of the Cuban professionals, requirements such as those under the Small Business Contractors should be pursued where they relate to native Cuban enterprises. This would support a rapid transition from their current system to one of competitive, free enterprise.

VI. CONSULTING AND COORDINATING WITH THE INTERNATIONAL COMMUNITY

The international community will play an important part in the modernization of Cuban infrastructure. One critical component of international involvement will concern the financial resources needed for the substantial infrastructure improvements that are needed in Cuba. In addition, a variety of international organizations have valuable technical expertise that will have an impact on the restoration of Cuban infrastructure. Many U.S. Government agencies have experience working with international entities and organizations to promote infrastructure modernization in developing nations, and this experience can be leveraged in support of a free Cuba.

The international community can help provide a free Cuba with access to important financial tools. While some financing for major capital investments may be available from the international financial institutions and bilateral sources, over time, the bulk of external financing for improvements in Cuba's infrastructure is likely to come from private sources.